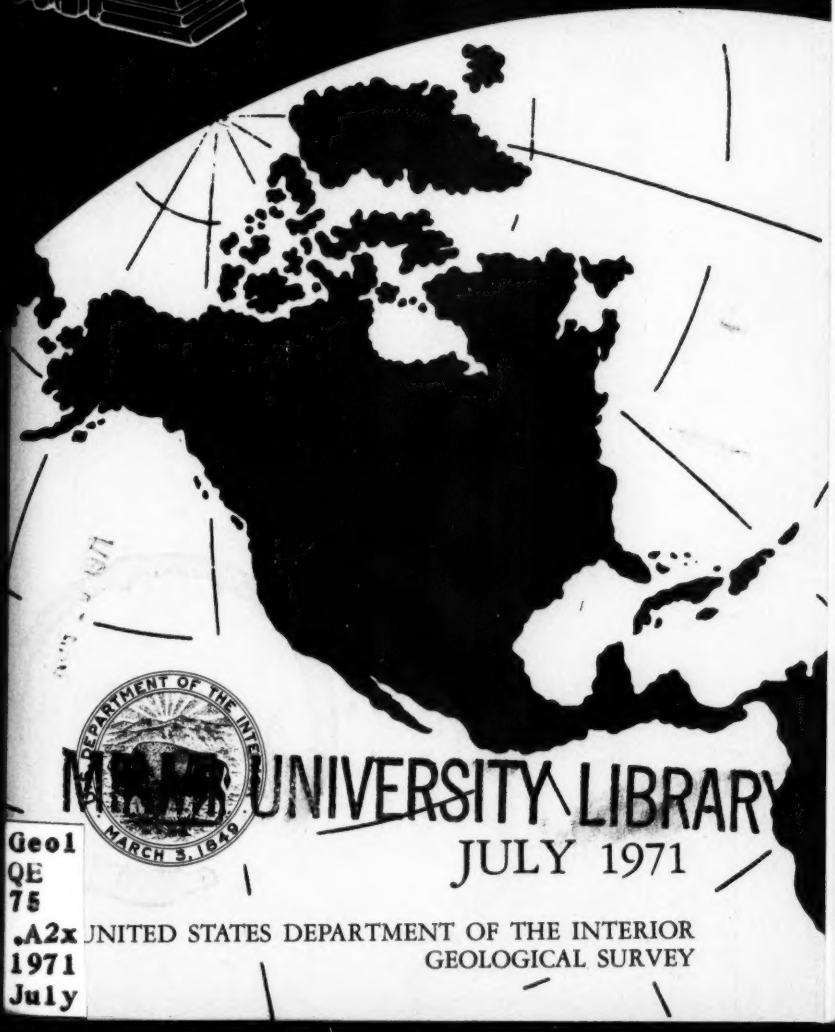
ABSTRACTS OF NORTH AMERICAN GEOLOGY



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ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

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The abstracts in this issue were prepared by Wlliam B. Cashion, James W. Clarke, Georgianna D. Conant, Howard R. Cramer, George H. Dixon, Elizabeth Hambleton, Virginia M. Jussen, Elisabeth S. Loud, Mildred C. Mead, Thomas E. Mullens, Virginia S. Neuschel, and Dorothy B. Vitaliano.

ABSTRACTS

Abdel-Hady, M. *See* Matalucci, R. V. 06732

Abelson, P. H. *See* Hare, P. E. 07010

06643 **Adams, W. M.; Furumoto, A. S.** Features of tsunamigenic earthquakes, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 57-68, illus., 1970.

Some seismological features of tsunamigenic earthquakes are studied, and the state-of-the-art for determining focal mechanisms is reviewed. The objective is to provide a basis for optimizing research on possible improvements for the tsunami warning system. The fact that only a single strike-slip earthquake is known to have generated a large tsunami indicates the potential value of additional real-time seismic data. Water-level gauges exist which could provide quantitative data in the source region, as opposed to "off-scale" reports. The prospects of using a satellite-based communication network are obvious. Hence, there are several possible ways for improving the tsunami warning system, so a decision on the optimal sequence of development must be made. The utilities required by statistical decision theory have not yet been estimated. — Authors' abstract

Adams, William M. *See* Walling, James M. 06722

06641 **Adams, William Mansfield.** (editor). Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, 513 p., illus., tables, 1970.

These proceedings document the scientific findings reported at the International Symposium on Tsunamis and Tsunami Research, held in Honolulu, Hawaii, on October 7-10, 1969. Representatives of seven countries participated. There were three seminars, "Seismic source and energy transfer," "Tsunami instrumentation," and "Tsunami propagation and run-up." In addition to the text of the papers presented under each of these headings, this volume contains two general reports, the text of the closing address, and the names and addresses of authors and conference participants. — DBV

06595 **Adegoke, Sylvester.** Stratigraphy and paleontology of the Neogene formations of the Coalinga region, California [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 755B-756B, 1970.

Adkison, W. L. *See* U.S. Geological Survey. 07074

06913 **Ahrens, L. H.** The composition of stony meteorites — [Pt.] [!6], The special significance of eucrites Stannern and Nuevo Laredo in lunar-meteorite comparative studies: Earth and Planetary Sci. Letters, v. 9, no. 4, p. 341-344, table, 1970.

Several refractory elements (Sc, Sr, Ba, Ti, Y, and rare earths, U and Zr) which are strongly enriched in the lunar surface, are enriched in eucrites Nuevo Laredo and Stannern relative to other eucrites and the howardites. Th appears to be an exception. The degrees to which these elements enrich, between average eucrites and eucrites Stannern and Nuevo Laredo, vary considerably. For Sc and Sr, the degree of enrichment is small (about 5-10 percent) whereas other elements (Zr, Ti, Ba, and particularly the rare earths, for example) are more strongly enriched (about 25-100

percent). Nuevo Laredo and Stannern appear to contain either similar or equivalent amounts of the refractory elements considered here. — Author's abstract

00183 **Ahrens, Thomas J.; Lower, John H.; Lagus, Peter L.** Equation of state of forsterite: Jour. Geophys. Research, v. 76, no. 2, p. 518-528, illus., tables, 1971.

Shock wave data for pure forsterite with initial bulk densities of 2.6 and 3.1 g per cu cm are obtained to 0.370 Mb by impacting specimens with tungsten alloy plates launched at speeds up to 2.3 kmps. Onset of a shock-induced phase change, probably corresponding to the forsterite-"post spinel" phase change, is observed at 0.280 ± 0.025 Mb. Because of the low shock temperatures, transition is believed to be limited by the reaction rate and this pressure value should be taken only as an upper limit. Adiabats derived from Hugoniot data for the forsterite phase are fit to the two-parameter finite strain Birch-Murnaghan equation and to two simple ionic equations of state. The Birch-Murnaghan form gives a zero-pressure bulk modulus (1.29 Mb) that agrees more closely with ultrasonic data than the modulus obtained from the ionic equation of state. An unusual relaxation effect, in which the elastic shock precursor velocity varies from 5.8 to 9.5 kmps, is also observed; time of the relaxation process appears to be less than 1 μsec. — *from* Authors' abstract

Aki, Keiiti. *See* Boore, David M. 00152

07082 **Alaska Geological Society.** (Stratigraphic Committee). The Sag River Sandstone and Kuparuk River sands, two important subsurface units in the Prudhoe Bay field, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. P1-P3, illus., 1970.

Two important subsurface units in the Prudhoe Bay field have been previously informally designated (Basye, 1969). The sand termed informally Oxytoma formation is herein named the Sag River Sandstone, and the other, the Kuparuk River pool, is described under the informal name Kuparuk River sands. The Sag River Sandstone is defined as the sandstone interval between the Jurassic Kingak Shale above and shales and limestones of the Triassic Shublik Formation below, in wells drilled in the Prudhoe Bay field, Alaska. The type section is the interval drilled in the ARCO-Humble Sage River State No. 1 well between 8,117 and 8,163 feet. The Kuparuk River sands occupy the interval containing several oil-productive sands from 6,774 to 7,054 feet depth in the Mobil-Phillips North Kuparu State No. 1 well. — VSN

07094 **Albee, Arden L.; Chodos, Arthur A.** Semiquantitative electron microprobe determination of Fe^{2+}/Fe^{3+} and Mn^{2+}/Mn^{3+} in oxides and silicates and its application to petrologic problems: Am. Mineralogist, v. 55, nos. 3-4, p. 491-501, illus., 1970.

The relative intensities of FeL_{alpha} and L_{beta} X-ray emission peaks differ significantly with valence state and bond association, even though the wavelength shift is very small. L_{beta}:L_{alpha} increases systematically with increase in Fe_{2+}:Fe^{3+} or Mn^{2+}:Mn^{3+} in their respective oxides, in the hematite-ilmenite series, in the magnetite-ulvospinel series, and in anhydrous silicates. FeL_{beta}:L_{alpha} ratios are much higher for Fe-O-Si and Fe-O-Ti bond associations than for Fe-O-Fe. L_{beta}:L_{alpha} ratios clearly distinguish ferric-rich alkali amphiboles from ferrous-rich calciferous amphiboles. No significant variation was found for the individual mineral types — chloritoid, staurolite, and cordierite, but a variation does occur in chlorite. Ferric-rich muscovite is not distinguishable from ferrous-rich biotite. — Authors' abstract

06852 **Alexander, E. C., Jr.** Rare gases from stepwise heating of lunar rock 12013: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 201-207, illus., tables, 1970.

He, Ne, Ar, and Xe data are presented from a 7 step heating of 12013. He, Ne, and Ar contain radiogenic and spallation components with no discernible trapped component. He-3 and Ne-21 cosmic ray exposure ages are 60 ± 12 m.y. The Xe contains a well defined spallation component, a fission component, and possibly a trapped component, but *no* evidence for decay products of extinct I-129 or Pu-244. Apparent solidification ages are UTh-He: 2.3 ± 0.5 b.y.; K-Ar: 3.0 ± 0.7 b.y.; U-238-Xe-136: 3.6 b.y. (assuming solar wind type xenon as trapped xenon) or 2.2 b.y. (assuming atmospheric trapped xenon). — *from* Author's abstract

Alexander, T. K. *See* Ollerhead, R. W. 06559

06891 **Al-Hashimi, Abdul Razak K.; Brownlow, Arthur H.** Copper content of biotites from the Boulder Batholith, Montana: Econ. Geology, v. 65, no. 8, p. 985-992, illus., tables, 1970.

Copper content of 61 biotites from rocks of the Late Cretaceous age, composite Boulder batholith ranges from 6 to 4, 395 ppm and averages 700 ppm. High copper values can be accounted for by presence of minute inclusions of sulfide minerals in the biotite. Highest copper contents in biotite are observed for samples from Butte Quartz Monzonite, largest single pluton of the batholith and host rock for rich deposits at Butte and many other major ore deposits. Plutons older or younger than the Butte have less copper in biotites. Within the Butte unit, higher values of copper in biotite tend to be found for rocks from a broadly defined, NNE-SSW-trending belt, which parallels the long dimension of the mass and contains the Butte district in the south and the Wickes and Clancy districts in the north. — *from* Authors' abstract

06688 **Allen, David William.** Sedimentary texture — A key to interpret deep-marine dynamics [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 828B-829B, 1970.

Allmann, Rudolf. *See* Donnay, Gabrielle. 06513

Am. Association of Petroleum Geologists. *See* U.S. Geological Survey. 07074

Anders, E. *See* Laul, J. C. 06854

06843 **Anderson, D. H.** Introduction — The preliminary examination and preparation of lunar sample 12013: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 94-102, illus., tables, 1970.

This issue of the journal is devoted to the study of lunar sample 12013, with numerous articles devoted to different aspects of the petrology of the same rock. This is a summary of the processes and techniques used to describe the most unusual rock returned from the lunar surface. Descriptions of various instrumental analyses, thin section examinations, and methods of dividing the rock into 46 samples for distribution and special analysis are included. — HRC

06691 **Anderson, Elaine.** Quaternary evolution of the genus *Martes* (Carnivora, Mustelidae): Acta Zool. Fennica 130, 132 p., illus., tables, 1970.

Living species of martens range widely throughout the forested regions of Eurasia and North America; the genus is first recorded from the lower Miocene of Germany. The 11 known Quaternary species are placed in three subgenera: *Martes*, (7 spp.); *Pekania*, fishers (2 spp.); *Charronia*, yellow-throated martens (2 spp.). *M. palaeosinensis*, early Pliocene, China, is the probable ancestor of the fishers, *M. diluviana*, middle Pleistocene, Pa., Md., Ark., and *M. pennanti*, late Pleistocene and living in northern U.S. and Canada. *M. vetus*, middle Pleistocene, Germany, is the probable ancestor of the closely related *M. martes*, *M. zibellina*, *M. melampus* (Eurasia), and *M. americana* (eastern North America), all late Pleistocene and living, and of *M. nobilis* n.comb., late Pleistocene, northwestern U.S. Ancestries of *M. foina* and *Charronia* are uncertain. — VMJ

00131 **Anderson, Orson L.; Demarest, Harold H., Jr.** Elastic constants of the central force model for cubic structures — Polycrystalline aggregates and instabilities: Jour. Geophys. Research, v. 76, no. 5, p. 1349-1369, illus., 1971.

The central force theory is extended to predict the elastic properties of polycrystalline aggregates of crystallites of the NaCl, ZnS, CsCl, and CaF_2 lattices, from zero pressure up to the point of a phase transition. Poisson's ratio at zero pressure is always equal to or greater than 0.25, according to the central force model. $dV_e:dP$ is negative for crystallites of the ZnS lattice, positive for the CsCl lattice, and may be negative or positive for the NaCl and CaF_2 lattice, depending on the details of the model. The point of phase transition is determined by the vanishing of a shear elastic

constant. In the transition from the NaCl to the CsCl structure, the central force model predicts a jump of about 35 percent in V_t and about 8 percent in V_p. — Authors' abstract

00115 **Anderson, R. Ernest.** Thin skin distension in Tertiary rocks of southeastern Nevada: Geol. Soc. America Bull., v. 82, no. 1, p. 43-58, illus., table, geol. map, 1971.

South of Lake Mead volcanic rocks of late Tertiary age, aggregating about 17,000 feet, are intensely faulted and distended by a system of closely spaced low-angle normal faults. Cumulative amounts of distension are as much as 20,000 feet, whereas vertical displacements are much less. The structural units are floored by complex low-angle zones of detachment into which the normal faults merge. Where the units abut along their strike they are separated by complex zones of transcurrent faults that appear to merge with the detachment structures. The extreme distension is viewed as a surficial feature of a crustal belt that was subjected to tensional rifting. — *from* Author's abstract

06805

Anderson, Roger Y. *See* Holser, William T. 07026

06728 **Andrews, Peter B.** Facies and genesis of a hurricane-washover fan, St. Joseph Island, central Texas coast: Texas Univ. Austin Bur. Econ. Geology Rept. Inv. 67, 147 p., illus., tables, 1970.

At the north end of this island, a 4 1/4 by 4-mi overwash fan grades northeastward into a subaerial tidal delta, both on Aransas Bay. With shell debris and sand from the inner neritic zone of the continental shelf deposited in large volumes by hurricane surges, the fan thickens from 25 or 30 in at edges to 50 in at apex. Each washover facies, grading upward from a shell placer base to laminated clean sand, has distributary channel subfacies. On the fan surface, eolian mounds of finer sand to mud facies prograde laterally, unimpeded except for hurricane scour. In the subaerial tidal delta, built up slowly in backwater, elongate ridges of shell debris and ubiquitous muddy sediments distinguish it from the washover fan and barrier island nucleus, both dominated by sand. C-14 dates indicate the tidal delta began 2400 years ago, the fan 1700; progradation was rapid at first, minimal for the last 450 years. — GDC

07081

06618 **Andrews, Peter William.** The effect of import quotas on the United States zinc industry [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 826B, 1970.

00163 **Andrichuk, J. M.** New stratigraphic technique predicts new reef trends: Oil and Gas Jour., v. 69, no. 4, p. 112-114, illus., 1971.

Studies of Upper Devonian Reefs in Alberta have demonstrated that the Leduc bioherms are superjacent and parallel to areas where there is an abrupt thickening of the underlying shale and micritic limestone unit. The areas of abrupt change in thickness are associated with flexures that probably reflect faults at depth in the Precambrian. A technique integrating structure, isopach, facies, and hydrocarbon maps has been developed to delineate areas that have optimum conditions for petroleum accumulation. — WBC

00133

06470 **Annells, R. N.** Keweenawan volcanic geology of Michipicoten Island, Lake Superior [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 7, 1970.

06574 **Anthony, John W.; Laughon, Robert B.** Kinoite, a new hydrous copper calcium silicate mineral from Arizona: Am. Mineralogist, v. 55, nos. 5-6, p. 709-715, illus., tables, 1970.

Kinoite, $Cu_3Ca_2Si_3O_{10}2H_2O$, a new species from the northern Santa Rita Mountains, Pima County, Arizona, occurs as single crystals and in veinlets associated with apophyllite, native copper, and copper sulfide minerals. It was found in drill cores

00135

which cut skarn associated with Paleozoic limestone. It is deep azure blue and transparent to translucent; density is 3.16 and hardness is 5. Optical data and X-ray crystallographic data are given. — JWC

Anthony, John W. *See* Williams, Sidney A. 06575

Appleman, D. E. *See* Dowty, Eric. 06959

Arem, Joel E. *See* Ito, Jun. 06580

06805 **Armstrong, Augustus K.** Carbonate facies and the lithostrotionid corals of the Mississippian Kogruk Formation, DeLong Mountains, northwestern Alaska: U.S. Geol. Survey Prof. Paper 664, 38 p., illus., table, 1970.

The Kogruk Formation of the Lisburne Group is 1,500-2,000 thick and is composed of carbonate rocks deposited in normal-marine to shoaling-water environments on a subsiding shelf where deposition and subsidence were near equilibrium. Two major lithostrotionid rugose coral faunas, of middle and late Meramec age, are described from four measured sections. The older fauna, 200-600 feet above the base, consists of *Lithostrotion* (*Siphonodendron*) *sinuosum*, *L.*(*S.*) *warreni*, *Lithostrotionella* aff. *banffensis*, *L. mclareni*, *Thysanophyllum astraeiforme*, *T. orientale*, *Sciophyllum lambarti*. The younger, in the top 600-800 feet, contains elements of the lower fauna plus *Lithostrotionella* spp. A and B, *L. banffensis*, *L. birdi*, *Thysanophyllum* sp. A. *Sciophyllum alaskensis*, *Faberophyllum* spp. Correlations with faunas in Alaska, western Canada, and northwestern U.S. are discussed. — VMJ

07081 **Armstrong, Augustus K.; Mamet, Bernard L.** Biostratigraphy and dolomite porosity trends of the Lisburne Group, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. N1-N16, illus., discussion, 1970.

Outcrops of the Lisburne Group, extending from Cape Lisburne in the west to Egaksrak River in northeastern Alaska, were used as basic data for carbonate facies maps and the cross section given here. Fauna is nonendemic and useful for correlation. Rugose corals can be used to zone Meramec age beds; they are rare in Chester age beds, but are of value in zonation of beds of the Pennsylvanian Wahoo Limestone. The lower Carboniferous part of the Lisburne was not a favorable environment for reef building; porosity is found in extensive dolomite blankets with sebkas controlled by pelmatozoan-bryozoan banks. The Pennsylvanian Wahoo Limestone reflects warming of waters and development of algal mats, spongiostromid mats, increasing bahamites, ooids and oolites, and greater microfaunal and microfloral diversity; porosity is still restricted to sebka-controlled dolomite blankets. Lisburne carbonates are thought to be an important petroleum target. — VSN

Arnold, K. *See* Ostrem, G. 06828

00133 **Artyushkov, E. V.** Rheological properties of the crust and upper mantle according to data on isostatic movements: Jour. Geophys. Research, v. 76, no. 5, p. 1376-1390, illus., table, 1971.

A physical analysis of the isostatic movements in Canada, in West Siberia, and in the region of Pleistocene Lake Bonneville in the Rocky Mountains is given. It is shown that the low-viscosity (of the order of 10^{20} poises) layer exists beneath the Canadian shield. The viscosity of the mantle under this layer is of the order of 10^{23} poises, or greater. Development of isostatic movements in the West Siberian lowland was rather similar to the development in the Fennoscandian and Canadian regions. The analysis of the uplift of Lake Bonneville shows that the lithosphere is very weak in the western United States and that its viscosity is of the order of 10^{21} poises. The main properties of isostatic adjustment and the nature of isostatic anomalies are discussed. It is shown that the sources of regional isostatic anomalies are located below the low-viscosity layer. — Author's abstract

00135 **Artyushkov, E. V.** Convective instability in geotectonics: Jour. Geophys. Research, v. 76, no. 5, p. 1397-1415, illus., 1971.

A hydrodynamical analysis is given of the Rayleigh-Taylor instability in fluids of high viscosity. The solutions are obtained in the linear approximation for two models: (1) two layers restricted by rigid walls, and (2) two layers restricted by a rigid wall and an inviscid fluid. These solutions are then investigated for different special situations. Some aspects of the development of instability are considered for a case when the deformation of the media obeys the creep laws. In conclusion, the instability in certain regions of the upper mantle is considered. — Author's abstract

Ault, W. U. *See* Richter, D. H. 06692

06797 **Axelrod, Daniel I.** Mesozoic paleogeography and early agniosperm history: Bot. Rev., v. 36, no. 3, p. 277-319, illus., 1970.

During Early Cretaceous, ocean-floor spreading gradually opened up the tropical Atlantic, and the Indian Ocean basin widened as the eastern segments of Gondwanaland were conveyed farther apart. At the same time, epeiric seas were advancing on all continents, reaching maximum extent during the Cenomanian. The resultant trend to widespread, more equable climate favored the invasion into the lowlands of angiosperms whose postulated origin was in mild uplands at low latitudes during pre-Cretaceous times. As tropical and subtropical lands were rafted farther apart by ocean-floor spreading following Albian-Cenomanian times, new taxa (species, genera, tribes, families) evolved in isolation. This accounts in part for the increasing richness of the three major tropical floras following the Cretaceous. — *from* Author's abstract

06471 **Ayres, Lorne D.** Synthesis of Early Precambrian stratigraphy north of Lake Superior [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 8, 1970.

06596 **Ayres, Lorne Dale.** Early Precambrian stratigraphy of part of Lake Superior Provincial Park, Ontario, Canada, and its implications for the origin of the Superior Province [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 756B, 1970.

06657 **Bader, Richard G.; Gerard, Robert D.; Benson, William E.; Bolli, Hans M.; Hay, William W.; Rothwell, W. Thomas, Jr.; Ruef, Michael H.; Riedel, William R.; Sayles, Fred L.** Initial reports of the Deep Sea Drilling Project — V. 4, covering Leg 4 of the cruises of the Drilling Vessel *Glomar Challenger*, Rio de Janeiro, Brazil to San Cristobal, Panama, February-March, 1969: Washington, D. C., U.S. Govt. Printing Office, 753 p., illus., tables, 1970.

The 10 chapters comprising Part I of this volume are shipboard site reports. Part 2, shore laboratory studies, contains 16 chapters, all of which are cited separately. Chapter 27, comprising Part III, is the cruise leg synthesis, also cited separately. The time-stratigraphic framework, sample list, and shore-based laboratory procedures comprise three appendices. Objectives of this leg of the project were to enhance knowledge of basins adjacent to continental margins, to investigate sea-floor spreading and the nature of transverse fractures in the Mid-Atlantic Ridge, to study geology of island arcs and trenches, and to explore the geologic history of the Caribbean. Sites 23-25 sampled the stratigraphic section near the continental margin of Brazil. Site 26 was in the Vema Fracture Zone where the crest of the Mid-Atlantic Ridge is offset 4,000 km to the east by the fracture. Sites 27-31, in the Caribbean, are cited separately. — ESL

06658 **Bader, Richard G.** (and others). Sites 27-31, Chaps. 6-10, *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 93-243, illus., tables, 1970.

Sites 27-31 of Leg 4 were in the Caribbean Sea: no. 27, in the northern Demerara Abyssal Plain; 28, on the Outer Ridge between Puerto Rican Trench and Nares Basin; 29, in the central Venezuela basin; 30, on the Aves Ridge to explore the fossil sequence in the upper Carib beds; and 31, on Beata Ridge to sample Horizon B and the oldest layered rocks in the Caribbean. — ESL

06668 **Baker, Earl W.** Tetrapyrrole pigments, Chap. 21 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 431-438, illus., table, 1970.

Chlorins and porphyrins, major classes of tetrapyrrole pigments, have been found in sediments; the first associated with recent sediments, and the second with ancient sediments and bitumen. Mass spectrometry has proved the most valuable method for determining structure of porphyrins in bitumens. Preliminary spectra on model compounds and pigments extracted from deep ocean sediments are reported, and the experimental methods described. — ESL

07061 **Bakker, Robert T.** Ecology of the brontosaurs: Nature, v. 229, no. 5281, p. 172-174, illus., 1970.

A reexamination of brontosaur anatomy shows that the evidence for their supposed semiaquatic habits is weak. The high, posterior position of the large external nares is a feature shared with terrestrial reptiles and mammals. The sauropod back, braced by powerful ligaments, tendons, and extra articulations, and the straight, elephantine limbs are obvious adaptations for supporting great weight for long periods on land. The deep chest, long limbs, and long neck seem to be browsing adaptation and not related to a hippotamus-like existence. The impact of brontosaurs on the Mesozoic terrestrial ecology must have been enormous. The herds must have opened up thick forest and kept underbrush from becoming dense, as African elephants do today. Smaller herbivorous dinosaurs adapted to woodlands and plains must have depended on sauropods to keep such habitats from being overrun by jungle. — DBV

06840 **Baldwin, Ralph B.** Summary of arguments for a hot Moon: Science, v. 170, no. 3964, p. 1297-1300, table, 1970.

Analysis of physical and chemical observations shows that the interior of the Moon is now and always has been hot. Although not necessarily molten, it is close to the melting point at each level beneath a cool outer zone. A transition zone in the outer few hundred km is inferred. — D.B.V.

Bambach, Richard K. *See* Holbrook, Sally Jean. 07024

Barger, R. L. *See* Boyne, H. S. 06627

06785 **Barker, Daniel S.; Burmester, Russell F.** Leaching of quartz from Precambrian hypabyssal rhyolite porphyry, Llano County, Texas: Contr. Mineralogy and Petrology, v. 28, no. 1, p. 1-8, illus., tables, 1970.

A Precambrian hypabyssal rhyolite porphyry in central Texas has retained its original texture, although alkali feldspar phenocrysts have inverted and unmixed from zoned, single-phase, high-temperature feldspar to zoned microperthite with an intermediate microcline host. Blue quartz phenocrysts owe their color to dispersion by zircon inclusions. Neutron activation analysis reveals substitution of tetravalent cations for silicon in the quartz. In two outcrops, quartz and albite have been completely leached from the rock and K-feldspar added, leaving the texture intact. The leaching was most likely accomplished by residual brine from an overlying Lower Cretaceous evaporite deposit subsequently removed by erosion. — Authors' abstract

07110 **Barnes, David F.** Gravity and other regional geophysical data from northern Alaska, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. I1-I20, illus., discussion, 1970.

The kinds of Federal government geophysical data available in Alaska are summarized. Aeromagnetic data obtained in 7 field seasons over a period of 20 years include the systematic survey of the Naval Petroleum Reserve, the only large area covered and probably almost the world's first large aeromagnetic survey; some reconnaissance lines in northeastern Alaska; some uncontoured profiles in the west; a small detailed survey on Noatak River, and a shipboard survey of the Chukchi

Shelf. Gravity coverage includes data obtained by the author and assistants for preparing a regional reconnaissance map of the State. The only detailed land data are from a survey of the Naval Petroleum Reserve. A preliminary Bouguer map of the State is illustrated. Broad features of gravity and magnetic data in northern Alaska are discussed and an effort is made to delineate geophysical boundaries of the sedimentary provinces. — VSN

Barnes, H. L. *See* Romberger, S. B. 07066

07099 **Barnes, Robert H.; Wilson, Charles W., Jr.; McCary, Charles E. L.** Geologic map of the Boonshill quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 73-NW, scale 1:24,000, separate text, 1970.

The accompanying text, "Mineral resources summary of the Boonshill quadrangle, Tennessee," by C. E. L. McCary is cited separately.

Baroffio, James R. *See* Wanless, H. R. 06708

Bauleke, Maynard P. *See* Tien, Pei-lin. 06915

06567 **Baur, Werner H.** Bond length variation and distorted corrdination polyhedra in inorganic crystals, *in* Symposium on intermolecular forces and packing in crystals, New Orleans, La., 1970, Proc.: Am. Cryst. Assoc. Trans., v. 6, p. 129-155, illus., tables, 1970.

Topics discussed include bond length and bond strength under which Pauling's postulate is refined and more crystal structures determined, hydrogen bonds and Δp, and bond angles and bond lengths. Rules worked out are applied to five problems to demonstrate their usefulness: criterion for correctly determined structures, detection of special bonding phenomena, prediction of bond lengths and angles of substances in a noncrystalline state, understanding of silicate crystal structures, and prediction of bond lengths and angles in poorly known structures. An appendix contains a table of short references to crystal structure of borates, silicates, phosphates, and sulfates, a total of 2,439 crystal structures. — ESL

Be, Allan W. H. *See* McIntyre, Andrew. 06697

Beardsley, George F., Jr. *See* Pak, Hasong. 06727

06821 **Begemann, F.; Vilcsek, E.; Nyquist, L. E.; Signer, P.** The exposure history of the Pitts meteorite: Earth and Planetary Sci. Letters, v. 9, no. 4, p. 317-321, illus., tables, 1970.

Concentrations of Cl-36, Ar-39, and the stable He, Ne, and Ar isotopes, show the Cl-36 and Ar-39 activities, extrapolated to the time of fall, were (13.7 ± 1.8) dpm/kg and (23.4 ± 2) dpm/kg, respectively. The Cl-36:Ar-39 ratio is about half the expected value and indicates a recent ($< 350{,}000$ yr ago) increase in the effective radiation flux. The abundance pattern of the stable rare gas isotopes is rather normal for an iron meteorite and, with the exception of the Ar-36:Ar-38 ratio, indicates an exposure age of 20-60 Ma. Detailed consideration shows the data to be consistent with a sudden increase in radiation flux between 150,000 and 300,000 yr ago, probably resulting from a secondary breakup. Space erosion is not a satisfactory alternative explanation. The effect of the postulated exposure history on the Ar-36:Ar-38 ratio is shown to be consistent with the observed value. — *from* Authors' abstract

Bender, P. L. *See* Boyne, H. S. 06627

06826 **Benedict, James B.** Frost cracking in the Colorado Front Range: Geog. Annaler, v. 52A, no. 2, p. 87-93, illus., 1970.

Frost cracks above timberline in the Colorado Front Range occur in turf-banked lobes and terraces and in other areas where differential frost heaving is locally intense. Crack widths vary seasonally, becoming gradually wider during the fall and

winter and narrower during the spring and summer. During 1965-66, seasonal variations in crack width at five experimental sites ranged from 0.7 to 8.6 cm. The locations, orientations, and seasonal behavior of the cracks suggest that they are caused by tensional forces resulting from extreme and localized frost heaving. — Author's abstract

Bennett, Richard H. *See* Keller, George H. 06764

06674 **Benson, W. E.; Gerard, R. D.; Hay, W. W.** Summary and conclusions, Chap. 27 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 659-673, illus., 1970.

The scientific objectives of most sites of Leg 4 were selected to enhance knowledge of several subjects, and the sites are not interrelated as in Legs 2 and 3. Conclusions resulting from knowledge of the geology of each site are presented first, followed by general discussion of several topics of particular interest, especially problems of sedimentation rates, history of calcium carbonate compensation in the Atlantic, and relations of subbottom reflecting horizons. — ESL

Benson, William E. *See* Bader, Richard G. 06657

00157 **Ben-Yaakov, S.; Kaplan, I. R.** Deep-sea in situ calcium carbonate saturometry: Jour. Geophys. Research, v. 76, no. 3, p. 722-731, illus., tables, 1971.

We used an in situ oceanographic system to measure the degree of saturation (IP/Ksp') of calcium carbonate. Results of two profiles measured in the eastern Pacific Ocean off southern California are described and compared with data obtained by conventional chemical techniques. From this preliminary study it appears that the waters investigated become undersaturated with calcite at a depth of approximately 400 m and remain so to a depth of about 1,600 m, where they move towards saturation. Below 2,500 m they appear to become undersaturated again and probably remain so to the depth of the ocean floor. — Authors' abstract

Beresnev, B. I. *See* Ryabinin, Yu. N. 00132

06830 **Berg, Thomas M.** A new fossil locality for Clearfield County: Pennsylvania Geology, v. 1, no. 9, p. 8-9, illus., 1970.

In a borrow pit on Boone Mountain north of Penfield, the middle part of the Lower Mississippian Pocono Formation yields plant and invertebrate fossils and a few fishbone fragments. Well-preserved leaves and stem impressions of at least two pteridophytes, *Adiantites* and *Lipidodendropsis*, may be collected. Abundant brachiopods of several genera occur, with some pelecypods, crinoid columnals, and rare bryozoans. These beds of the Pocono were part of a deltaic complex that covered much of central Pennsylvania during the Mississippian. — VMJ

06626 **Berger, J.** Design considerations of laser strain meters, *in* Laser applications in the geosciences (J. Gauger and F. F. Hall, Jr., editors) — Symposium, Huntington Beach, Calif., 1969, Proc.: North Hollywood, Calif., Western Periodicals Co., p. 203-213, illus., 1970.

A strainmeter is a device which measures change in length of a given base length. To make measurements to one part in 10^{10}, the integrated temperature must be known or be stable to 2×10^{-10}, which necessitates strict environmental control of the strainmeter over its entire length. Laser strainmeters allow use of very short length standards, and laser interferometric strainmeters have been operated successfully over distances to 1 km. The high resolution and wideband linear response make the L.S.M. ideal to investigate the whole spectrum of earth strains. Freedom from environmental control of the entire base length permits a portable design that operates on the surface. However, strain measurements on an unequal arm instrument are dependent on laser wavelength stabilization. — VSN

06548 **Bergh, H. W.** Paleomagnetism of the Stillwater Complex, Montana, Chap. 17 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 143.158, illus., tables, 1970.

For paleomagnetic studies of the Stillwater Complex, 167 cores were drilled at 15 localities, 12 on East Boulder Plateau and three in the Mouat Mine area. Stratigraphically the sites range from the Bronzitite member of the ultramafic zone up through the Norite, lower gabbro, to the subzone 3 of the anorthosite zone. Paleomagnetic poles calculated for each of the nine sites are tabulated; the mean pole position is lat 62° S., long 68° W. Comparisons are made with other Precambrian pole positions in North America. It is calculated that the dipole field at the time of intrusion, 3 b.y. ago, has an intensity about two-thirds as strong as the present field. — VSN

06472 **Berkson, J. M.; Clay, C. S.** Side-scan sonar survey of the Lake Superior floor near Freda, Michigan [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 9, 1970.

Bernstein, Hyman. *See* Inouye, George T. 06859

Bertine, Kathe K. *See* Turekian, Karl K. 00192

Best, M. G. *See* Hamblin, W. K. 06923

06926 **Best, M. G.; Brimhall, W. H.** Late Cenozoic basalt types in the western Grand Canyon region, *in* The western Grand Canyon district: Utah Geol. Soc. Guidebook to Geology of Utah, no. 23, p. 57-74, illus., tables, 1970.

First, in petrologic investigation of these basaltic rocks for their evolution and origin, is to establish what chemical-petrographic types exist within the space-time framework for the lavas. Chemical and petrographic data were obtained from about 300 samples, systematically collected at various heights in each unit and horizontally within less than 100 yards. The various samples chemically analyzed fall within the alkalic field on an alkalies-silica plot of Hawaiian basalts. Mineralogically, Grand Canyon basalts are characterized by ubiquity of phenocrystic and groundmass olivine and of augitic pyroxene; Grand Wash, Craig's Ranch, Middleton, Uinkaret, and Washington basalts are described. Most extensive in time and space is the Grand Wash basalt, its composition essentially unchanged; next widespread is the Uinkaret; others in later eruptions are more diverse. An eastward migration of volcanism is paralleled in faulting activity of the region. — GDC

06927 **Best, M. G.; Hamblin, W. K.** Implications of tectonism and volcanism in the western Grand Canyon, *in* The western Grand Canyon district: Utah Geol. Soc. Guidebook to Geology of Utah, no. 23, p. 75-79, illus., 1970.

Denudation here is a consequence of active stream erosion and uplift; less clearly related are simultaneous basaltic volcanism and vertical tectonics. Concurrently shifting extrusion and high-angle faulting, independent vents, coincidental cinder cones, sinuous fault lines, and inclusions in basalts indicating shallow origin, contrast with geologic observation for the adjoining Basin and Range and Colorado Plateaus. Geophysical data relate to crustal thickness, P and S waves, heat flow, geothermal gradient, and geomagnetism. The apparently shallow tensional faulting could not directly cause rise of basalt magma from upper mantle. Below-crust inflation, much larger than in a shield volcano, would cause uplift, thin and extend the crust to such faulting; but no basaltic "megalaccolith" near the crust base is supported by seismic data. Convective rise of hot mantle towards the Moho seems best to satisfy available facts. — GDC

Best, M. G. *See* Hamblin, W. K. 07073

06894 **Beutner, E. L.** Genesis of Precambrian iron deposits, Rio Arriba County, New Mexico [discussion of paper by D. F. McLeroy, 1970]: Econ. Geology, v. 65, no. 8, p. 1008, 1970.

For the paper under discussion, *see* ibid., v. 65, no. 2, p. 195-205, 1970; Abs. North America Geology, March 1971.

06905 **Bhattacharyya, B. K.** Some important considerations in the acquisition and treatment of high-resolution aeromagnetic data, *in* Colloquium on basement mapping by magnetics — Aarhus, Denmark, 1969 [with Italian abs.]: Boll. Geofisica Teor. ed Appl., v. 12, nos. 45-46 (spec. issue), p. 21-44, illus., 1970.

Theoretical calculations on treatment of high-resolution aeromagnetic data to determine the effect of spatial errors in the flight path on the shape and magnitude of magnetic anomalies are discussed. Also, the assumption that the difference between total fields measured by two magnetometers in the gradiometer mode is linearly proportional to the true gradient of the anomalous total field may lead to erroneous interpretation if the separation between magnetometers is not very small compared to height of the lower magnetometer above the surface. To keep this error within reasonable limits necessitates selection of a small ratio of height separation and careful reduction of measured gradient data for removal of spatial variation of the vertical gradient of the geomagnetic field. Consideration is given also to line spacing, elevation of aircraft, and flight path. — *from* Author's abstract

07049 **Bidwell, L. E.; Winter, T. C.; Maclay, R. W.** Water resources of the Red Lake River watershed, northwestern Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-346, 4 sheets, scales 1:500,000 and 1:250,000, text, 1970.

Sheet 1 contains information on physical setting and summary, and climate and water yield; sheet 2, ground water; sheet 3, surface water; and sheet 4, base flow and water recreation, and water quality. Ground water for domestic and stock use can be obtained at most places in the Red Lake River watershed; for larger yield wells, the best potential is in the outwash and ice-contact areas. Yields of wells tapping sand and gravel lenses are generally less than 25 gpm; however, by exploratory test drilling, aquifers yielding several hundred gpm have been located. Ground water ranges from the calcium magnesium type at depth generally less than 50 feet to highly mineralized water of the sodium chloride type at great depth in the western area. — MCM

07095 **Bird, J. Brian.** The final phase of the Pleistocene ice sheet north of Hudson Bay, *in* Problemy Czwartorzędu: Acta Geog. Lodziensia 24, p. 75-87, illus., table, 1970.

Evidence from physical setting, marine transgression, C-14 shell dates, stratigraphy, and landforms supports earlier views that the Pleistocene ice sheet left residual caps on Southampton Island in northern Hudson Bay. At least four may have melted within four or five centuries; the largest, 7,000 yr B.P., may have had a perimeter close to the present 200 m contour in the uplands. The ice margin seems to have retreated principally from south and west; how long remnants lasted in the northeast part of the island is not known. Cirques here appear to have been occupied by ice in postglacial times. Excepting a few nunataks exposed as the ice thinned, most deglaciation of lowlands in the final instance was rapid. A preliminary time-scale for exposure of Southampton Island is possible, from which to determine rates of postglacial, periglacial weathering and slope development. — GDC

Bird, M. L. *See* Duke, M. B. 06963

06758 **Birkhead, Paul K.; Murray, James W.** *Actinostroma papillosum* (Bargatzky, 1881), a stromatoporoid from the Swan Hills Member of the Waterways Formation (Upper Devonian) of Alberta: Jour. Paleontology, v. 44, no. 6, p. 1067-1070, illus., 1970.

Study under reflected light of some enigmatic fossils found in the Upper Devonian Swan Hills Member, Judy Creek, Alberta, proved them to belong to *Actinostroma papillosum* (Bargatzky, 1881). Stearn's hypothesis (1968) that these questionable stromatoporoids represent a diverse group of species seems to be applicable in this case. — Authors' abstract

06867 **Bishko, Donald.** Planning for common mineral resources in the urban-suburban environment, a computer simulation approach [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 164B-165B, 1970.

06713 **Biswas, Asit K.** History of hydrology: Amsterdam and London, North-Holland Publishing Co., *and* New York, American Elsevier Publishing Co., 336 p., illus., table, 1970.

This book is an outgrowth of several papers written on the history of hydrology and published in various journals. Chapter headings are: hydrology prior to 600 B.C., Hellenic civilization, age of Plato and Aristotle, post-Aristotelian period, Roman civilization, origin and rise of the River Nile, from 200 to 1300 A.D., 16th century, 17th century, beginning of quantitative hydrology, rain gauges in the 17th and 18th centuries, 18th century, and 19th century. References are given at the end of each chapter, and a subject index is appended. — MCM

06694 **Bjork, Philip Reese.** The Carnivora of the Hagerman local fauna (late Pliocene) of southwestern Idaho: Am. Philos. Soc. Trans., new ser., v. 60, pt. 7, 54 p., illus., tables, 1970.

The beds containing the local fauna (Hagerman lake beds of Stearns, 1936) are considered a flood-plain facies of the Glenns Ferry Formation, deposited to a thickness of over 550 feet in a recurrently down-faulted basin, as fine-grained clastics in small stream channels that drained into Lake Idaho. Eight measured sections west of Snake River are correlated; K-Ar dating of two intercalated volcanic ash beds indicates early Blancan age. The flood plain supported many aquatic and near-stream vertebrates, including at least 17 carnivore species; the most abundant are *Satherium piscinaria* (otter), *Trigonictis idahoensis* (grison), *Canis lepophagus*, *Felis lacustris*; association indices are calculated for these. A new species of bear, *Ursus abstrusus*, and new genera and species of mustelids, *Ferinestrix vorax*, *Sminthosinis bowleri*, are described. — VMJ

07065 **Black, R. F.** Glacial geology [summ.] *in* Geology of the Baraboo district, Wisconsin: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 14, p. 65-77, illus., 1970.

No field study of the geomorphology or glacial geology of the map area was attempted for this report. Only the position of the prominent terminal moraine of Late Woodfordian age was refined by aerial photographic interpretation and limited field checks, and thus this note is largely a synthesis of the literature. A brief description of the terminal moraine is followed by descriptions of features associated with it, by evidence of greater deployment of the ice, and by a synopsis of the glacial history, including the geomorphic evolution of some major land forms. — *from* Author's introduction

06809 **Black, Robert F.** (and others). Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, papers paged separately, illus., tables, 1970.

This report contains a field-trip guide and nine special papers, cited separately in this volume, and a list of references, prepared for the annual meeting of the Geological Society of America and Associated Societies in Milwaukee, November, 1970. The papers cover aspects of the Pleistocene geology of the Milwaukee, Madison, and Monroe areas of Wisconsin. — EH

06810 **Black, Robert F.; Bleuer, Ned K.; Hole, Francis D.; Lasca, Norman P.; Maher, Louis J., Jr.** Field trip guide, Pt. A *in* Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, p. A1-A38, illus., 1970.

This two-day field trip was designed to show representative sections of the Pleistocene stratigraphy; representative glacial features, particularly drumlins and landforms marginal to the Driftless Area; and a glimpse of the Driftless Area. Drifts of Wisconsinan and pre-Wisconsinan age were seen at nine of eleven stops. Pertinent time stratigraphic units, the Valderan, Twocreekan, Woodfordian, and Altonian Substages of the Wisconsinan Stage, and one or more pre-Wisconsinan stages are included in a chart. The report is subdivided into ten parts involving the Milwaukee,

Madison and Monroe areas. For each area portions of the road log, stop descriptions and narrative reports are included, as well as sections on soils, drumlins of Jefferson County, pollen, and Twocreekan flora. — EH

06814 **Black, Robert F.** Cross Plains terminal moraine and related features, Pt. G *in* Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, p. G1-G15, illus., 1970.

The Cross Plains terminal moraine of the late Woodfordian or Cary ice advance lies about 10 mi west of Madison and marks the east boundary of the Driftless Area of Wisconsin. On the uplands a typical portion of the Johnstown Moraine is present. Deposits of a typical proglacial stream are found in Black Earth Creek Valley. The author summarizes Alden's (1918) account of the Johnstown Moraine in which differences in time of deposition and thickness of the moraine are recognized. Along the field trip route, the contrast is discussed between drift-mantled surfaces behind the Johnstown front, where drift ranges from a few feet thick on the uplands to tens of feet thick in valleys, and the thinly loess-mantled valley slopes and hill tops beyond the front. The absence of older loess and residuum on the bedrock outside the front is, in the author's opinion, due to earlier glaciation. — EH

06815 **Black, Robert F.** Blue Mounds and the erosional history of southwestern Wisconsin, Pt. H *in* Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, p. H1-H11, illus., 1970.

The author summarizes the literature on the erosional history of the Blue Mounds in the Driftless Area in southwestern Wisconsin. West Blue Mound, an outlier of the Niagara escarpment, is 1716 feet above sea level and is capped with 85 feet of chert and silicified dolomite of Niagaran (silurian) age. Maquoketa Shale (upper Ordovician) occurs between the 1630- and 1380-ft contours. East Blue Mound, 1490 feet above sea level, is capped with about 80 feet of Maquoketa Shale and 2 to 4 feet of loess. Some geologists accept the hypothesis of noncyclic cuesta formation versus one or more peneplanation cycles as the basis of the present-day landforms. The author and others have concluded that the Driftless Area had been glaciated. Some facts point to the possibility that glaciation removed the Niagara dolomite and much of the Maquoketa Shale from East Blue Mound, but the question of why this did not also happen to West Blue Mound has not been solved. — EH

06911 **Black, Robert F.** Residuum and ancient soils of the the Driftless Area of southwestern Wisconsin, Pt. I *in* Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, p. I1-I12, illus., tables, 1970.

The Driftless Area of southwestern Wisconsin has widespread Cambrian and Ordovician dolomites which contain abundant clay and chert. If the rocks have undergone weathering since Mesozoic times, residuals from solution should be thick and widespread unless flushed from the system. The thickest deposit of *in situ* residuum known south of the Wisconsin River is an 8-ft section of clay. The author approximates the amount of residual clay and chert in the Driftless Area and compares it with the total that should have been left from the rocks now gone. He assumes that rapid erosion by glacial ice, periglacial processes and wind removed the bulk of the residuum and ancient soils. — EH

Blair, G. R. *See* Chaklader, A. C. D. 06929

Bleuer, Ned K. *See* Black, Robert F. 06810

06912 **Bleuer, Ned K.** Glacial stratigraphy of south-central Wisconsin, Pt. J *in* Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, p. J1-J35, 1970.

This report concerns the glacial geology of that part of south-central Wisconsin east of the Driftless Area and south and west of the Woodfordian moraines. Mappable surficial units are distinguished and correlated with equivalent units in adjacent parts of Illinois. The sequence, distribution, and characteristics of five mappable till units and a gravel unit are given, and the glacial history of the area is reconstructed. The informal terms Janesville till, Janesville gravel, and Juda gravel are introduced. — EH

06665 **Blow, W. H.** Deep Sea Drilling Project, Leg 4 foraminifera from selected samples, Chap. 18 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 383-400, tables, 1970.

This report consists of a biostratigraphic summary of available samples, and descriptions of faunas examined, both arranged by hole numbers. Leg 4 drilling sites were off the Brazilian coast and in the Caribbean Sea. — ESL

Bollard, Lise. *See* Murty, T. S. 06646

Bolli, Hans M. *See* Bader, Richard G. 06657

06672 **Bolli, Hans M.** The foraminifera of sites 23-31, Leg 4, Chap. 25 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 577-643, illus., 1970.

In this study all samples could not be analyzed, but spacing in critical intervals is close enough that bottoms and tops of zones of most species are reasonably accurate. Some new species and subspecies are found and described, but their actual presentation as new taxa will appear elsewhere. Some electron microscope micrographs are included. Planktonic foraminifera, other microfossils, nature of residue, zone, and age for sites 23-31 are described. Correlation of the Caribbean sites 29-31 with Jamaica, coastal Venezuela, and Trinidad is discussed. A preliminary comparison of the upper Miocene-Pliocene in well Bodjonegoro-1, Java, with these new findings has resulted in some revisions for the well. — ESL

Bonis, S. B. *See* Rose, W. I., Jr. 06916

06473 **Bonnichsen, Bill.** The southern part of the Duluth Complex and associated Keweenawan rocks, Minnesota [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 10-11, 1970.

00152 **Boore, David M.; Larner, Kenneth L.; Aki, Keiiti.** Comparison of two independent methods for the solution of wave-scattering problems — Response of a sedimentary basin to vertically incident SH waves: Jour. Geophys. Research, v. 76, no. 2, p. 558-569, illus., 1971.

The transient solution to several problems, obtained by numerical integration of equations of motion using a finite difference technique, is compared with the complex-frequency solutions obtained by the approximate wave theoretical method of Aki and Larner [1970]. Most of the paper is devoted to a discussion of two models relevant to the engineering-seismological study of earthquake motions in soft layers of varying thicknesses. It is found that lateral reverberations of waves produced by the nonplanar structure form complex interference patterns not predicted by the usual flat-layer approximations. In one example, constructive interference enhances the peak amplitude of transient motion over the center of the basin by a factor of 3 relative to flat-layer solutions. The results indicate that a realistic appraisal of earthquake hazards in areas underlain by soft surficial layers should include the effect of nonuniformity in the structure. — *from* Authors' abstract

Bottino, M. L. *See* Schnetzler, C. C. 06850

Boucot, A. J. *See* Gray, Jane. 06993

Bown, M. G. *See* Gay, P. 06845

06627 **Boyne, H. S.; Hall, J. L.; Barger, R. L.; Bender, P. L.; Ward, J.; Levine, J.; Faller, J.** Absolute strain measurements with a 30 meter vacuum interferometer, *in* Laser applications in the geosciences (J. Gauger and F. F. Hall, Jr., editors) — Symposium, Huntington Beach, Calif., 1969, Proc.: North Hollywood, Calif., Western Periodicals Co., p. 215-225, illus., 1970.

Details are presented on the design and performance of a 30-m interferometric strain gage, and a practical method is discussed for recording absolute earth strain measurements by comparing length changes in the interferometer with an absolute wavelength standard. The instrument described is in the Poorman Relief Mine west of Boulder, Colorado, and consists of a pair of 50-m radius-of-curvature mirrors mounted inside vacuum boxes at each end of a 30-m vacuum envelope mounted on concrete piers; a third pier holds beam steering optics and optical isolators. The interferometer is excited by a He-Ne laser operating at 633 nm; wavelength is controlled by locking the laser cavity to a short high-finesse Fabry Perot. — VSN

06651 **Braddock, R. D.** Tsunami propagation over large distances, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 285-303, illus., tables, 1970.

The Grid Refinement Technique is an iterative procedure which employs discrete methods to obtain sequences of approximate solutions to continuous optimal problems. This technique is applied to the propagation of tsunamis over large distances, and the results of calculations on the propagation of the Alaskan tsunami of 1946 demonstrate its capabilities. The ray paths of the Alaskan tsunami of 1964 to various localities along the west coast of America were calculated and the propagation of the wave system into this region is discussed. In the southwest Pacific, the wave system was dispersed by the complex bathymetry northeast of Australia. However, some of the wave energy entered the Tasman Sea by way of the Fiji Basin, and its subsequent reflection by the Undulla Deep explains the late arrival times in New Zealand and at Macquarie Island. — Author's abstract

06587 **Brahma, Chandra Sekhar.** Analysis of granular soil deformation as a stochastic process [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 662B, 1970.

Bransby, Peter L. *See* Finn, W. D. Liam. 06773

06737 **Brede, E. C.; Johnston, R. C.; Sullivan, L. B.; Viger, H. L.** A pneumatic seismic energy source for shallow water/marsh areas: Geophys. Prosp., v. 18, no. 4, p. 581-599, illus., 1970.

Non dynamite seismic energy sources have shown only limited success in difficult shallow-water or marsh prospect areas, and none have applicability to both environments. Recently, a method has been devised to adapt a marine pneumatic source for operation in abrasive surroundings. A system composed of four of these modified sources together with associated emplacement and retrieval mechanisms has been developed and has proven to be a reliable and efficient seismic energy source for both shallow-water and marsh applications. — Authors' abstract

06506 **Breger, Irving A.; Chandler, John C.; Zubovic, Peter.** An infrared study of water in heulandite and clinoptilolite: Am. Mineralogist, v. 55, nos. 5-6, p. 825-840, illus., tables, 1970.

Infrared determinations have shown that the water in heulandite and clinoptilolite exists in two forms. When heulandite is heated slowly, part of the initial water is lost rapidly at first and then slowly up to 200°C. The heulandite-heulandite B transition occurs between 255° and 330°C. The dehydration curve for clinoptilolite is similar to that for heulandite, except that loss of tightly bound water begins at 185° to 190°C.

At 500°C both heulandite and clinoptilolite retain about 20 percent of their initial bound water. The infrared technique has proved to be effective for handling very small hygroscopic specimens in dehydration studies. — *from* Authors' abstract

Brennan, Daniel J. *See* Galbraith, Frederic W. 06766

Breslau, Lloyd. *See* Grantz, Arthur. 07076

Brett, Robin. *See* Reid, Arch M. 06841

06771 **Bridgwater, D.** Observations on the Precambrian rocks of Scandinavia and Labrador and their implications for the interpretation of the Precambrian of Greenland, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 43-47, 1970.

Three main groups of Precambrian rocks visited in a cooperative venture were: in older basement, corresponding to pre-Ketilidian complexes of Greenland, last metamorphosed about 2500 m.y. ago; in the Svecofennid and Hudsonian fold belts corresponding to the Ketilidian and Nagssugtoqidian fold belts, metamorphosed 1400 to 2000 m.y. ago; and postorogenic intrusions, lavas and sediments corresponding to the Gardar magmatism and sedimentation of South Greenland. Within different areas of the North Atlantic Shield are such general similarities, both in types of sedimentation and in subsequent plutonic development, that the various stages must mark fundamental changes in crustal environment. Specific points of possible stratigraphic application to Greenland are noted in the character of early basement rocks of eastern Labrador, general structure of the younger fold belts, and setting of the anorthosites of the Labrador coast. — GDC

Brimhall, W. H. *See* Best, M. G. 06926

06474 **Brisbin, W. C.** The structure of the northern Lake of the Woods greenstone belt, a deformational mosaic [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 12, 1970.

Broecker, Wallace S. *See* Imbrie, John. 07031

00158 **Bromfield, Calvin S.; Crittenden, Max D., Jr.** Geologic map of the Park City East quadrangle, Summit and Wasatch Counties, Utah: U.S. Geol. Survey Geol. Quad. Map GQ-852, scale 1:24,000, sections, 1971.

06555 **Brookins, Douglas G.; Woods, Michael J.** Rb-Sr geochronologic investigation of basic and ultrabasic xenoliths from the Stockdale kimberlite, Riley County, Kansas: Kansas: Kansas Geol. Survey Bull. 199, pt. 2, 12 p., illus., table, 1970.

Ages of formation and subsequent thermal history are determined for five xenoliths of deep seated origin in Stockdale kimberlite. Diorite, age about 1600 m.y., dates formation of basement igneous material; initial Sr-86:Sr-87 ratio is extremely low, and constituent minerals are not recrystallized. Representing post-formational events, one hypersthene gabbro, with secondary K-feldspar evidence of an open system, had a spurious age of about 82 m.y.; another at about 700 m.y. dates crustal metamorphism of Grenville type; garnet granulite, 240 m.y. old, indicates metamorphism in upper mantle long after that in overlying crust; eclogite lacked data to calculate its age. These scattered but internally consistent data argue for several thermally active periods prior to entrapment in host kimberlite, and suggest it was a hot mass or its ascent was very rapid and relatively cool. — GDC

06556 **Brookins, Douglas G.; Woods, Michael J.** High pressure mineral reactions in a pyroxenite granulite nodule from the Stockdale kimberlite, Riley County, Kansas: Kansas: Kansas Geol. Survey Bull. 199, pt. 3, 6 p., illus., 1970.

Sapphirine, kyanite, and a grossular-rich garnet have formed by reactions involving spinel, pyrope-almandine, clino- and orthopyroxene, and plagioclase in a pyroxenite

granulite nodule from the Stockdale kimberlite, Kansas. The reactions responsible for formation of these minerals are thought to have occurred at pressures in excess of 13.5 kb (corresponding to a depth of formation of approximately 40 km), thus placing the source material for the nodule in the upper mantle. Sapphirine and kyanite are reported for the first time from the Riley County, Kansas, kimberlites. — Authors' abstract

06557 **Brookins, Douglas G.** Factors governing emplacement of Riley County, Kansas, kimberlites: Kansas: Kansas Geol. Survey Bull. 199, pt. 4, 17 p., illus., tables, 1970.

Geometry and theory indicate these kimberlites, under explosive conditions of abrupt tectonic activity about 120 m.y. ago, may have nearly reached the surface; fluid velocity attained 400 m/sec, at 100° to 150°C. Low temperatures are also indicated by pre-emplacement K-Ar dates on chloritized phlogopites, fission track dates on apatites from xenoliths, and lack of pyrometamorphic contact effects. On the basis of stability conditions necessary for ilmenite-pyroxene intergrowths in the Stockdale kimberlite, it is proposed that kimberlites crystallized in upper mantle in the late Precambrian(,), at depth between 120 and 300 km. Injected upward, sporadically as indicated by phlogopite kink bands, they may have passed through a water-rich, low P-wave zone. Rising in the crust at even higher velocity, there was little capture of upper Precambrian basement rocks; many Paleozoic sedimentary xenoliths were entrapped upon significant near-surface pressure drop. — GDC

06558 **Brookins, Douglas G.** The kimberlites of Riley County, Kansas: Kansas: Kansas Geol. Survey Bull. 200, 32 p., illus., tables, 1970.

In northern Riley County the pipelike bodies of the Bala, Leonardville, Stockdale, and two Randolph kimberlites dip steeply southeast about normal to the Abilene anticline and consist chiefly of serpentine and calcite derived from intruded lower Permian rocks. Bala and the two Randolphs are classified as lamprophyric, and the other three as micaceous kimberlites; no two are exactly alike in mineralogy, bulk chemistry, or texture. Randolph No. 2 contains only a few serpentinized xenoliths; the others have abundant accidental xenoliths from the country rocks with a few from Precambrian basement. The Stockdale has abundant cognate mafic xenoliths. Age of the pyrope, 745 ± 100 m.y., may date the original kimberlite crystallization in the upper mantle. Final emplacement in Late Cretaceous may have come close to the surface in a post-Dakota sandstone. Carbonatitic material helped fluidize it and kept temperatures low (75°-150°C); the gas-rich phase probably dissipated at depth. — GDC

Brosge, Mary M. *See* U.S. Geological Survey. 07074

Brosge, W. P. *See* Tailleur, I. L. 07075

07104 **Brosgé, W. P.; Tailleur, I. L.** Depositional history of northern Alaska, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. D1-D18, illus., discussion, 1970.

The stratigraphy of the North Slope of Alaska is summarized from a review of selected references. A generalized geologic map and cross section and various facies maps and sections are included. There is an apparent orderly northward progression of older to younger rocks from Devonian schist along the axis of the Brooks Range geanticline to Tertiary sedimentary rocks along the northeast coast. On the south, the geanticline is flanked by Jurassic volcanic and Cretaceous sediments of Koyukuk basin. The basement of Paleozoic or older rocks under the Colville geosyncline does not dip continuously northward but rises from depths of 20,000 feet or more in the southern Colville geosyncline to only 10,000 to 2,500 feet in wells from Prudhoe Bay to Barrow to form the Arctic Platform. A narrow Disturbed Belt extends E-W across west and central mountain fronts marked by thrust faults, and comprising mostly lower Mesozoic and upper Paleozoic rocks. — VSN

06772 **Brown, Edwin T.** Strength of models of rock with intermittent joints: Am. Soc. Civil Engineers Proc., v. 96, paper 7697, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 1935-1949, illus., tables, 1970.

A series of triaxial compression tests, at 0-2000 psi, were carried out on five sample types containing various patterns of preformed intermittent jointing. The 4-in. square by 8-in. high samples were built up from parallelepipedal and hexagonal blocks of high strength gypsum plaster exhibiting rock-like mechanical properties. The seven modes of failure observed include axial cleavage and a dilational mode at low confining pressures, shear failure through the plaster, planar and non-planar shear failures partly through plaster and partly along the joints, and the formation of multiple conjugate shear planes at higher confining pressures, either exclusively through plaster or partly through it and partly along joints. Where failure was by planar shear, partly through plaster, and partly along joints, the averaging process for calculating shear strength was first proposed by the Austrian School of rock mechanics. — *from* ASCE abstract

Brown, F. F. *See* Hogarth, D. D. 06638

06636 **Brown, J. B.** A chemical study of some synthetic potassium-hydronium jarosites: Canadian Mineralogist, v. 10, pt. 4, p. 696-703, tables, 1970.

Jarosite was synthesized at 25°C and 1 atm. Results indicate that potassium-rich jarosites are formed from solutions with ak^+/aH_3O^+ as low as 0.3 whereas hydronium substitution for potassium apparently is facilitated at higher temperatures (Kubisz 1964; Brophy and Sheridan 1965). The free energy for jarosite at 25°C, 1 atm is given a value. — Author's abstract

07039 **Brown, L. F., Jr.; Eifler, Gus K., Jr.; Garner, L. Edwin; Maxwell, Ross A.** The state parks *in* Geologic and historic guide to the state parks of Texas: Texas Univ. Austin Bur. Econ. Geology Guidebook 10, p. 28-197, illus., table, 1970.

A short sketch is given of the history, geography, and general geologic background of each of 64 recreation, scenic, and historic parks and historic sites in Texas. Small geologic maps for some of the parks are included. — EH

06739 **Brown, W. G.; Johnston, G. H.** Dikes on permafrost — Predicting thaw and settlement [with French abs.]: Canadian Geotech. Jour., v. 7, no. 4, p. 365-371, illus., 1970.

Prediction of permafrost thaw and settlement of dikes constructed on perennially frozen ground is important for maintenance and foundation stability. A method is developed for estimating the rates of thaw and settlement, based on simple heat-conduction theory. A comparison of calculated and observed rates of thaw for dikes on ice-rich foundation soils at the Kelsey Generating Station in northern Manitoba shows good agreement and indicates that thaw and settlement rates can be predicted with reasonable accuracy. — Authors' abstract

Brownlow, Arthur H. *See* Al-Hashimi, Abdul Razak K. 06891

Brummer, J. J. *See* Coats, C. J. A. 06890

Bucci, D. R. *See* Whalin, R. W. 06723

Buchan, R. *See* Coats, C. J. A. 06890

06808 **Bufe, Charles G.** Frequency-magnitude variations during the 1970 Danville earthquake swarm: Earthquake Notes, v. 41, no. 3, p. 3-7, 1970.

Significant variations in the earthquake magnitude-frequency relation were found to occur during the earthquake swarm of May-June 1970 near Diablo, California. Periods of maximum elastic strain release were preceded and accompanied by marked decreases in "b." — Author's abstract

Bunch, T. E. *See* Olsen, Edward. 06576

Burdick, D. W. *See* Furnish, W. M. 00173

Burmester, Russell F. *See* Barker, Daniel S. 06785

06846 **Burnett, D. S.; Monnin, M.; Seitz, M.; Walker, R.; Woolum, D.; Yuhas, D.** Charged particle track studies in lunar rock 12013: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 127-136, illus., 1970.

Fossil particle tracks in Ca-feldspar, K-feldspar, and pyroxene are attributed to galactic cosmic rays. The feldspar age of lunar exposure is $15 \pm 3 \times 10^6$ yrs. Etch pits of phosphate minerals are inhomogeneously distributed and are more dense than the background density of cosmic ray tracks and could be produced from U fission. U-distribution maps show strong local concentrations that are frequently, if not always, associated with phosphates. One such age is $\leq 1.4 \times 10^9$ yr, suggesting partial recovery. No evidence for excess fission tracks from the decay of Pu-244 is found. The track density rises sharply toward the surface showing the effects of low energy solar particles. By studying the track densities in the vicinity of an impact pit, it is concluded that the pit was formed relatively recently in the history of the rock ($\leq 3 \times 10^6$ yr ago). — HRC

00188 **Burnham, C. Wayne; Davis, N. F.** The role of H_2O in silicate melts [Pt.] 1, P-V-T relations in the system $NaAlSi_3O_8$-H_2O to 10 kilobars and 1000°C.: Am. Jour. Sci., v. 270, no. 1, p. 54-79, illus., tables, 1971.

The apparent average compressibility of this system up to 10 kb, at 20°C, is 2.46×10^{-6} bar^{-1} and is about 18 percent greater than that previously obtained on single cylinders of albite; this discrepancy is attributed to an anomalously high density of a small percentage of the interstitial H_2O. Volumetrically, both $\overline{V}_w$ and $\overline{V}_w$ were found to be independent of the mole fraction of H_2O. This compositional independence of $\overline{V}_w$ permitted the fitting of a third degree polynomial in T and P to the graphical values of $\overline{V}_w$. The resulting equation of state is $\overline{V}_w = 10.98 + 0.962T + 0.1005T^2 - 0.00199T^3 - P(0.530 + 0.2031T + 0.00158T^2) + P^2(0.0780 + 0.01144T) - P^3(0.00396)$, where $\overline{V}_w$ is in cm^3 mol^{-1}, P is in kb, and T is in hundreds of degrees C. Recasting volumetric data in terms of $\overline{V}_{OH}$, data suggest that the principal mechanism of solution in the melt (m) is by the reaction $H_2O + O^{2-}(m) = 2OH^-(m)$. — *from* Authors' abstract

06568 **Busing, William R.** (editor). Symposium on intermolecular forces and packing in crystals, New Orleans, La., 1970, Proc.: Am. Cryst. Assoc. Trans., v. 6, 155 p., illus., tables, 1970.

The purpose of this symposium is to reduce the communications gap between crystallographers and those working on other manifestations of intermolecular forces. Eight papers comprise the symposium, one of which is cited separately. — ESL

06704 **Butera, Anthony W.; DeMatteo, John J.; Goclowski, John C.** Direct measurement of deflection of the vertical using a ship's inertial navigation system (SINS), *in* Marine geodesy, a practical view — Symposium on Marine Geodesy, 2d, 1969: Washington, D. C., Marine Technology Soc., p. 129-136, illus., table, 1970.

A technique has been developed for direct at-sea measurements of vertical deflection of gravity, utilizing a ship's inertial navigation system (SINS), a geodetic position reference such as LORAC or LORAN and an "Inverse SINS Filter." Utilizing this new technique aboard USS Compass Island, the vertical deflection was measured over Blake Escarpment and Puerto Rico Trench. Measurements over Blake Escarpment were compared to previous measurements by classical methods and differences were found to be 1.5 arc-sec rms. The SINS deflection measurements over Puerto Rico Trench represent the first accurate ones taken and were estimated to accurate to 2.9 arc-sec rms. This technique requires much less time for survey and post trip reduction than currently used deflection techniques, yet affords accuracies meeting the most rigid requirements. — *from* Authors' abstract

Butler, J. C. *See* Cameron, K. L. 06509

Byerlay, J. R. *See* Doonan, C. J. 07106

Cabri, L. J. *See* Harris, D. C. 06753

Callaghan, Eugene. *See* Pratt, Alan R. 07036

06698 **Cameron, Cornelia C.** Peat deposits of northeastern Pennsylvania: U.S. Geol. Survey Bulk 1317-A, p. A1-A90, illus., tables, 1970.

Peat resources in a 900-sq-mi area in northeastern Pennsylvania are estimated at more than 13 million short tons of air-dried peat, chiefly of good quality reed-sedge type. Ninety-five peat deposits in the Appalachian Mountains were studied. These represent various geologic settings related to structural control of bedrock and to differential erosion. Physical and chemical analyses of samples show that specific characteristics of the peat can be related to distribution of bedrock and unconsolidated material surrounding each deposit and to the size and position of the drainage basin. — *from* Author's abstract

06509 **Cameron, K. L.; Carman, M. F.; Butler, J. C.** Rhönite from Big Bend National Park, Texas: Am. Mineralogist, v. 55, nos. 5-6, p. 864-874, tables, 1970.

A new occurrence of rhönite is reported from a mafic alkaline sill in western Texas. Chemical analysis and pleochroism closely match those of material from Rhön, Germany; however, optical properties are different. X-ray powder data indicate a strong similarity to aenigmatite. Unit cell refinement was made, and the chemical formula was calculated. No evidence was obtained concerning possible solid solution between rhönite and aenigmatite. —JWC

00039 **Canada Geological Survey.** Aeromagnetic series, Bronson Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4627, scale 1:63,360, 1971.

00040 **Canada Geological Survey.** Aeromagnetic series, Barthel, Saskatchewan: Canada Geol. Survey Geophysics Paper 4628, scale 1:63,360, 1971.

00041 **Canada Geological Survey.** Aeromagnetic series, Horsehead Creek, Saskatchewan: Canada Geol. Survey Geophysics Paper 4629, scale 1:63,360, 1971.

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00050 **Canada Geological Survey.** Aeromagnetic series, Falling Horse Creek, Saskatchewan: Canada Geol. Survey Geophysics Paper 4638, scale 1:63,360, 1971.

00051 **Canada Geological Survey.** Aeromagnetic series, Baird Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4639, scale 1:63,360, 1971.

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00056 **Canada Geological Survey.** Aeromagnetic series, St. Walburg, Saskatchewan: Canada Geol. Survey Geophysics Paper 4644, scale 1:63,360, 1971.

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00058 **Canada Geological Survey.** Aeromagnetic series, Helene Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4646, scale 1:63,360, 1971.

00059 **Canada Geological Survey.** Aeromagnetic series, Leoville, Saskatchewan: Canada Geol. Survey Geophysics Paper 4647, scale 1:63,360, 1971.

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00061 **Canada Geological Survey.** Aeromagnetic series, Debden, Saskatchewan: Canada Geol. Survey Geophysics Paper 4649, scale 1:63,360, 1971.

00062 **Canada Geological Survey.** Aeromagnetic series, Halkett Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 4650, scale 1:63,360, 1971.

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00086 **Canada Geological Survey.** Aeromagnetic series, Otosquen, Saskatchewan: Canada Geol. Survey Geophysics Paper 4674, scale 1:63,360, 1971.

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00088 **Canada Geological Survey.** Aeromagnetic series, Maidstone, Saskatchewan: Canada Geol. Survey Geophysics Paper 4676, scale 1:63,360, 1971.

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00095 **Canada Geological Survey.** Aeromagnetic series, Prince Albert, Saskatchewan: Canada Geol. Survey Geophysics Paper 4683, scale 1:63,360, 1971.

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00102 **Canada Geological Survey.** Aeromagnetic series, Ceba Creek, Saskatchewan: Canada Geol. Survey Geophysics Paper 4690, scale 1:63,360, 1971.

00103 **Canada Geological Survey.** Aeromagnetic series, Green Lake, Saskatchewan: Canada Geol. Survey Geophysics Paper 7231, scale 1:253,440, 1971.

00104 **Canada Geological Survey.** Aeromagnetic series, Ile-a-la-Crosse, Saskatchewan: Canada Geol. Survey Geophysics Paper 7235, scale 1:253,440, 1971.

00105 **Canada Geological Survey.** Aeromagnetic series, Pasquia Hills, Saskatchewan: Canada Geol. Survey Geophysics Paper 7742, scale 1:253,440, 1971.

00106 **Canada Geological Survey.** Aeromagnetic series, Prince Albert, Saskatchewan: Canada Geol. Survey Geophysics Paper 7743, scale 1:253,440, 1971.

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00110 **Canada Geological Survey.** Aeromagnetic series, Wapawekka, Saskatchewan: Canada Geol. Survey Geophysics Paper 7755, scale 1:253,440, 1971.

00111 **Canada Geological Survey.** Aeromagnetic series, Pelican Narrows, Saskatchewan: Canada Geol. Survey Geophysics Paper 7764, scale 1:253,440, 1971.

00112 **Canada Geological Survey.** Aeromagnetic series, Lac la Ronge, Saskatchewan: Canada Geol. Survey Geophysics Paper 8190, scale 1:253,440, 1971.

06469 **Canada Geological Survey.** Aeromagnetic series, Hazelton, British Columbia: Canada Geol. Survey Geophysics Paper 7768, scale 1:253,440, 1970.

06529 **Canada Geological Survey.** Principal mineral areas of Canada: Canada Geol. Survey Map 900A, 20th edition, scale 1:7,603,200, 1970.

06530 **Canada Geological Survey.** Isotopic age map of Canada: Canada Geol. Survey Map 1256A, scale 1:5,000,000, 1970.

06801 **Canadian Hydrographic Service.** (compiler). Bathymetric chart, Lake Ontario (881): Ottawa, Ontario, Canada Dept. Energy, Mines and Resources, Marine Sci. Br., scale 1:400,000, 1970.

06885 **Caner, Bernard.** Electrical conductivity structure of the lower crust and upper mantle in western Canada [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 258B, 1970.

07054 **Carlisle, V. W.; Schoon, C. L.** Stratification in a Spodosol: Soil and Crop Sci. Soc. Florida Proc. 1969, v. 29, p. 332-336, table, 1970.

Particle size distribution of the sand fractions, organic matter content and heavy mineral separations were investigated for three profiles of a Spodosol occurring at the Indian River Field Laboratory, Ft. Pierce, Fla. Morphological characteristics of this soil below the spodic horizon included fine-textured horizons with lenses or pockets of sandy material. Profile development to a depth below the spodic horizon and including the upper fine-textured horizon appeared to have formed in a pedogenic manner from deposition of homogeneous parent material. Data collected indicated a lithologic discontinuity immediately below the first fine-textured horizon and varying amounts of stratification in succeeding fine-textured layers. Source of sediments was similar as indicated by virtual identity in the heavy mineral suite of all horizons. — Authors' abstract

Carman, John H. *See* Gaffey, Michael J. 06987

Carman, John H. *See* Ghose, Subrata. 06988

Carman, M. F. *See* Cameron, K. L. 06509

06544 **Carmichael, C. M.** The intensity of the Earth's paleomagnetic field from 2.5×10^9 years ago to the present, Chap. 9 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 73-77, illus., 1970.

The paleomagnetic field intensity from 25 m.y. ago to the present is outlined on the basis of determinations on basaltic lava. No allowance was made for spontaneous demagnetization of natural remanence with time. The intensity of the field for the past few thousand years and in the Tertiary has shown a variation from about one-half to twice the present value. If this has always been characteristic of the field, then considerable scatter can be expected for any time period. Determinations, shown graphically, indicate that field intensity for a large part of Precambrian time was as great or greater than now. Toward the end of Precambrian and during early Paleozoic, it was quite low, rising during latter Paleozoic and Mesozoic time to present values. Where a statistically significant number of values is available from one formation, results show a variation in intensity similar to the four-fold variation of the recent field. — VSN

Carmichael, I. S. E. *See* Stormer, J. C., Jr. 06787

Carozzi, A. V. *See* Roche, J. E. 06908

06678 **Carozzi, Albert V.** Robert Hooke, Rudolf Erich Raspe, and the concept of "earthquakes": Isis, v. 61, pt. 1, no. 206, p. 85-91, illus., 1970.

Hooke's "Lectures and discourses of earthquakes and subterranean eruptions" (1705) introduced into structural geology the dynamic concept of vertical movements of the crust, attributing the origin of islands, continents, ocean basins, mountains and valleys to effects of volcanic eruptions and "earthquakes" in the broad

sense of diastrophic movements. Raspe (1763) revived Hooke's concept, providing detailed amplification of mechanisms of continent formation and mountain building by uplift and subsidence of crystalline basement and its sedimentary cover, with erosion, folding, fracturing, and mineralization. After gaining wide acceptance, the concept of vertical movements was superseded in the late 19th century by the geosynclinal theory and related horizontal movements, but has been considered important in some recent orogenic hypotheses. — VMJ

Carpenter, David. *See* Motts, Ward S. 06520

06653 **Carrier, G. F.; Shaw, R. P.** Response of narrow-mouthed harbors to tsunamis, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 377-398, illus., 1970.

The response of a narrow-mouthed harbor of general shape in a straight coast to a transient incident wave with the bulk of its energy spectrum at long periods (in the range of 3 - 60 minutes), e.g., a tsunami, is found as a Fourier synthesis of a corresponding time-harmonic solution which has been recently developed. The harbor basin is connected to the open sea by a narrow straight channel of arbitrary length (which may be zero) and a uniform depth is assumed for the basin, the channel, and the sea. — Authors' abstract

Carroll, Henry C. *See* Jenkins, Charles R. 07091

06770 **Carter, John L.; Carter, Ruth C.** Bibliography and index of North American Carboniferous brachiopods (1898-1968): Geol. Soc. America Mem. 128, 382 p., 1970.

This bibliography and accompanying index supplements and brings up to date through December 1968, Weller's *Bibliographic index of North American Carboniferous invertebrates* (U.S. Geol. Survey Bull. 153, 1898). Weller's bibliography is duplicated in part by Schuchert's *Synopsis of American fossil Brachiopoda* (U.S. Geol. Survey Bull. 87, 1897). Species citations not accompanied by descriptions and/or illustrations are not included. Locality and stratigraphic information is briefly summarized at the end of the citation list for each species. — *from* Authors' preface

Carter, Ruth C. *See* Carter, John L. 06770

Cazeau, Charles J. *See* Peterson, Robert W. 06716

06632 **Černy, Petr.** Compositional variations in cookeite: Canadian Mineralogist, v. 10, pt. 4, p. 636-647, illus., tables, 1970.

Assuming an ideal anionic composition, the lithium-aluminum chlorite cookeite shows a fairly constant tetrahedral population Al_2Si_4; subordinate B and Be may occasionally substitute for Al. Some Na, Ca, Mg, and K, Fe^{2+} can play the role of octahedral cations; the large cations may be accommodated between the 2:1 sandwiches and "brucite" sheets. The main octahedral substitution is $3(Li, alk.)^{1+}/Al^{3+}$, probably extending up to Li-low and Li-free donbassite and sudoite, and that involving the bivalent cations is $3R^{2+}/2Al^{3+}$. Some fluorine substitutes frequently for OH. There seems to be no need for the name "hydrocookeite". — Author's abstract

06929 **Chaklader, A. C. D.; Blair, G. R.** Differential thermal study of FeO and Fe_3O_4 [with French, German, and Russian abs.]: Jour. Thermal Analysis, v. 2, no. 2, p. 165-179, illus., tables, 1970.

Two batches of wüstite were produced from a stoichiometric mixture of Fe and Fe_2O_3 by sealing in steel tubes in vacuum and helium, respectively, and igniting the first tube at 1300° for 21 hours and the second one at 1200° for 34 hours. There were two exothermic peaks on the DTA curves of both samples at 345° and 545° to 700° due to surface oxidation of FeO to Fe_3O_4 followed by bulk oxidation of FeO to Fe_3O_4 and of Fe_3O_4 to α-Fe_2O_3. The last two reactions gave rise to a dual (or twin) peak for coarse material but one peak in the case of fine material, indicating that the two reac-

tions occurred concurrently for fine material. Similar investigations on both fine and coarse magnetites showed only two exothermic peaks which corresponded to surface and bulk oxidation, respectively. This result confirms the previous observations that coarse magnetite converts to α-Fe_2O_3 by surface oxidation followed by bulk oxidation. — Authors' abstract

06869 **Chamberlain, Charles Kent.** Trace fossils and paleoecology of the Ouachita Mountains of southeastern Oklahoma [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 248B, 1970.

Chan, K. M. *See* Sayles, F. L. 06666

Chan, R. K. C. *See* Street, R. L. 06655

Chandler, John C. *See* Breger, Irving A. 06506

Chesters, G. *See* Konrad, J. G. 06930

Chigareva, O. G. *See* Fedoseev, A. D. 06508

07037 **Childers, Barbara S.; Smith, Bernice Y.** (compilers and editors). Abstracts of theses concerning the geology of Utah to 1966: Utah Geol. and Mineralog. Survey Bull. 86, 233 p., 1970.

This annotated bibliography contains all graduate theses concerned with the geology of Utah in addition to a few entries of a theoretical nature that are pertinent to a particular mineral deposit or locality in the state. Subject and university indexes are included. — MCM

Chodos, Arthur A. *See* Albee, Arden L. 07094

06563 **Christensen, Cleo M.; Stephens, Jerry C.** Geology and water resources of Clay County, South Dakota — Pt. 3, Basic data: South Dakota Geol. Survey Bull. 19, pt. 3, 107 p., illus., tables, 1970.

This report makes basic data available for future planning and study and for use in conjunction with parts 1 and 2 which were published in 1967. Tabulated data are: records of selected wells, springs, and test holes; chemical analyses of water from selected wells in the principal aquifers; and selected logs of wells and test holes in Clay County (and vicinity). — MCM

Christiansen, R. L. *See* Doe, B. R. 06955

Christie, J. M. *See* Green, H. W., 2d. 06759

00139 **Church, W. R.; Stevens, R. K.** Early Paleozoic ophiolite complexes of the Newfoundland Appalachians as mantle-oceanic crust sequences: Jour. Geophys. Research, v. 76, no. 5, p. 1460-1466, illus., 1971.

Layered ultramafic-mafic complexes of the Northwest platform and the Fleur de Lys orthotectonic zones of the Newfoundland Appalachians are comparable to layered Tethyan ophiolite suites. They can be interpreted as oceanic crust and mantle (peridotites = upper mantle, gabbros and "sheeted" diabases = layer 3, and pillow lava, chert, and graywacke = layers 2 and 1). The ophiolites may represent an intrasialic small ocean basin. Thrust emplacement of the ophiolite sheets may reflect an Early Ordovician phase in the closing of an Appalachian ocean basin by underthrusting of the North American plate along a southeasterly-dipping Benioff zone; final closing during late Ordovician was effected by subduction of oceanic crust during northwest drift of the European plate. Alternatively, the ophiolites may have been emplaced directly into the Fleur de Lys at time of inception of an ocean-forming ridge in a geosyncline on a continental sialic basement, or during an ocean-closing phase drift. Newfoundland ophiolites may be the oldest lithosphere in North America. — DBV

07102 **Churkin, Michael, Jr.** Fold belts of Alaska and Siberia and drift between North America and Asia, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. G1-G14, illus.; discussion, p. G15-G17, 1970.

Extensions of fold belts of Alaska into Asia can be observed around the rim of the northern Pacific basin; a less obvious correlation of fold belts is around the edge of the Canada basin. Stratigraphic comparisons reveal a close correlation of depositional history for Cenozoic, Paleozoic, and possibly Precambrian times. In later stages, these belts were affected by uplifts, intrusions, and clastic wedge sedimentation. No direct evidence exists for large-scale drift between Alaska and Chukotka. The sea-floor spreading that formed the Atlantic basin extended across much of the Eurasia basin part of the Arctic, possibly the result of a wedge-like opening hinged at the northern end of the Verkhoyansk fold belt. Bends in large-scale structures in Alsaka and Chukotka may be the result of compression in this narrow continental segment linking two continents. — VSN

06505 **Cifrulak, S. David.** High pressure mid-infrared studies of calcium carbonate: Am. Mineralogist, v. 55, nos. 5-6, p. 815-824, illus., tables, 1970.

The infrared analysis of calcite to pressures of 61 kbar, obtained by means of a high-pressure diamond cell equipped with type II diamond anvils, has shown spectroscopically that a new high pressure polymorph of calcium carbonate is produced at pressures above 30 kbars having a "vaterite-type" structure. — Author's abstract

Clark, Joan R. *See* Finney, J. J. 06500

Clark, L. A. *See* Shimazaki, Hidehiko. 06633

Clark, L. A. *See* Coats, C. J. A. 06890

06583 **Clark, Lee Jay.** Hydration characteristics of K-depleted mica [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 474B, 1970.

Clark, R. G., Jr. *See* Hatch, Norman L., Jr. 06695

Clay, C. S. *See* Berkson, J. M. 06472

06834 **Clendening, John A.** Historical review of the age designations of the Dunkard strata in West Virginia: West Virginia Geol. Survey Newsletter, issue 14, p. 3-5, illus., 1970.

The Dunkard Group of western West Virginia and parts of Ohio, Maryland, and Pennsylvania, the youngest division of Paleozoic rocks in the Appalachian region, is significant in that it represents a transitional phase from the coal swamp to a more emergent environment. The author reviews research done since the late 1800's on this group, which has, until recently, been considered of Permian age. Recent palynological evidence established by the author substantiates an upper Pennsylvanian age for the Dunkard Group sequence. — EH

06475 **Clifford, Paul M.** Behaviour of an Archaean granite diapir [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 13, 1970.

06476 **Clifford, Paul M.** Mt. St. Joseph, an Archaean volcano [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 14-15, 1970.

Clifford, Paul M. *See* Hsu, Mao-Yang. 06481

06890 **Coats, C. J. A.; Clark, L. A.; Buchan, R.; Brummer, J. J.** Geology of the copper-zinc deposits of Stall Lake Mines Lts., Snow Lake area, N. Manitoba: Econ. Geology, v. 65, no. 8, p. 970-984, illus., tables, 1970.

The copper-zinc deposits of Stall Lake Mines Ltd. in the Snow Lake area of Manitoba are interpreted as being of metamorphosed volcanogenic origin. Some of the massive chalcopyrite and sphalerite ores occur in highly elongate, stratiform lenses. Known deposits occur in the uppermost layers of a thick rhyolitic ash formation, now resembling quartz "porphyry," near its contact with overlying basaltic tuffs and flows. Metamorphism to the amphibolite facies has caused extensive conversion of pyrite to pyrrhotite. Plastic deformation and remobilization of the sulfide ores has probably yielded a preferential enrichment of the more plastic minerals, especially chalcopyrite and sphalerite. — Authors' abstract

06864 **Coen, Gerald Marvin.** Clay mineral genesis in some New York Spodosols [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 17B-18B, 1970.

07101 **Cole, J. Glenn.** Marmaton Group, east flank of the Nemaha Ridge, north-central Oklahoma: Shale Shaker, v. 21, no. 3, p. 52-67, illus., 1970.

The Oswego Limestone is the lowest unit in the Marmaton genetic sequence of strata; five subdivisions are recognized. The Labette Shale, a wedge separating the Oswego from the Oologah Limestone, varies in thickness from 10-220 feet. Channel-type sandstones are present in the shale. The Oologah is a succession of carbonates divisible into three members mapped as a unit. To the south the carbonates thin rapidly, disappearing into a shale sequence. The Cleveland genetic increment has a well-defined top at the base of the Checkerboard, and a poorly defined base; thickness ranges from 100 feet in the north to over 900 feet in the south, due to disappearance of carbonate units. Much sandstone is present. Two types of maps illustrate the nature of the Marmaton genetic sequence — carbonate-sandstone isolith, and D-function lithofacies maps; isopach maps are also included. The sequence represents a change from clastic sedimentation to carbonate development; a multiple source direction is indicated. — ESL

00121 **Coleman, R. G.** Plate tectonic emplacement of upper mantle peridotites along continental edges: Jour. Geophys. Research, v. 76, no. 5, p. 1212-1222, illus., 1971.

A mechanism of peridotite emplacement is proposed which overcomes major petrogenetic problems and is consistent with both the new global tectonics and field observations on alpine ultramafics. In zones of "obduction" (tectonic overriding) there is a complete lack of volcanicity and high-pressure metamorphism; during formation they can be represented by shallow seismic zones dipping oceanward. The association of peridotites and blueschists in these belts may be due to collision between an oceanic and continental plate. Disturbed zones and lack of high-temperature contacts between cold mantle-peridotite slabs and trench sediments are evidence of emplacement by obduction. Internal subsolidus plastic deformation of these peridotites is due to strain deep in the upper mantle during spreading. Serpentinites represent alteration during tectonic emplacement into wet sediments. Recognition of these peridotite-serpentinite blueschist belts within exhumed subduction or obduction zones allows delineation of ancient collision between lithospheric plates. — DBV

00160 **Colton, Roger B.; Hartshorn, Joseph H.** Surficial geologic map of the West Springfield quadrangle, Massachusetts and Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-892, scale 1:24,000, sections, text, 1971.

Pre-Pleistocene geology of the West Springfield quadrangle, which lies in the Connecticut Valley lowland, was probably much the same as at present; evidence of multiple advances of glaciation is lacking. Till thickness probably averages about 15 feet. Ice moved generally south, but as the glacier decreased in thickness, the ice front retreated northward. Stratified drift deposits are abundant and varied. Much of the eastern third of the quadrangle is underlain by lake deposits of thin alternating layers of clay and silt, which accumulated in pro-glacial Lake Hitchcock. Postglacial geology is evidenced by terrace, eolian, talus, and swamp deposits, and alluvium. Economic resources are till, clay, sand and gravel. — MCM

06819 **Corey, J. C.; Hayes, D. W.** Determination of density and water content of marine sediment in an unextruded core using fast neutron and gamma ray attenuation: Deep-Sea Research, v. 17, no. 5, p. 917-922, illus., 1970.

Water content and sediment density were measured rapidly and nondestructively at 2.5-cm intervals along a 75-cm long unextruded core (10.75 cm i.d.) using attenuation measurements of collimated gamma rays (0.66 MeV) and collimated fast neutrons (fission spectrum). Nondestructively determined sediment densities and water contents compared well with destructively determined values (mean difference = 0.01 g/cm^3). — *from* Authors' abstract

06937 **Corliss, John B.** Regional chemical diversity of Mid-Atlantic Ridge basaltic liquids [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 526-527, 1970.

Corte, Arturo E. *See* Higashi, Akira. 00168

06560 **Cowley, E. R.** Refractive indices of some carbonate minerals in the point dipole approximation: Canadian Jour. Physics, v. 48, no. 1, p. 297-302, tables, 1970.

The refractive indices of minerals with the calcite and aragonite structures are analyzed in the point dipole approximation to give values for the polarizabilities of the individual ions. It is found that the experimental measurements are consistent with several models for the polarizability of the carbonate group, but that the use of a single anisotropic polarizability for the whole group is unreliable. Emphasis is placed on the use of the Ewald transformation and on the correct use of symmetry to increase the efficiency of the calculations. — Author's abstract

06725 **Cox, Doak.** Ecumenical tsunamigaku, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 489-493, 1970.

This address, delivered at the end of the International Symposium on Tsunamis and Tsunami Research, discusses two groups of aspects of tsunami research which can be subsumed under the deliberately hybrid title "ecumenical tsunamigaku," (tsunamigaku = the science or study of tsunamis). The first group of aspects is geographic, for many parts of the world are involved, and the subject brings together scientists from nations of all political colors. The second group is disciplinary, for the study involves both seismology and oceanography at its very heart, and with them tectonics, geology, instrumentation engineering, communications engineering, ocean and coastal engineering, and so on. — DBV

Craddock, Campbell. *See* Mooney, Harold M. 06582

06938 **Craddock, Campbell; Mooney, Harold M.** Geologic structure under the northern midcontinent gravity high [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 527-528, 1970.

Craig, H. *See* Kroopnick, P. 06760

06510 **Craig, James R.** Livingstonite, $HgSb_4S_8$, synthesis and stability: Am. Mineralogist, v. 55, nos. 5-6, p. 919-924, tables, 1970.

Systematic silica tube experiments have confirmed the composition of livingstonite as $HgSb_4S_8$ and established its maximum thermal stability as 451 ± 3°C. The approximate free energy of formation of livingstonite at 300° and 400°C are calculated from knowledge of the equilibrium S_2 vapor pressure. — Author's abstract

06939 **Craig, James R.** Violarite stability relations [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 528, 1970.

06940 **Crawford, María Luisa.** Phase relations of feldspars in contact metamorphic rocks [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 528-529, 1970.

Crelling, John C. *See* Dutcher, Russell R. 06964

Crittenden, Max D., Jr. *See* Bromfield, Calvin S. 00158

06941 **Cronan, D. S.; Thomas, R. L.** Geochemistry of ferromanganese oxide concretions in Lake Ontario [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 529, 1970.

06942 **Cronin, J. F.; Williams, R. S., Jr.** Volcanism and the upper atmosphere [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 529-530, 1970.

06943 **Cross, Aureal T.** The evaluation of an Allegheny (Pennsylvanian) coal seam, West Virginia [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 530, 1970.

00151 **Crosson, Robert S.; Lin, Jia-Wen.** Voight and Reuss prediction of anisotropic elasticity of dunite: Jour. Geophys. Research, v. 76, no. 2, p. 570-578, illus., tables, 1971.

Aggregate anisotropic elastic constants were calculated for two nearly monomineralic dunites by both the Voight and the Reuss averaging schemes. The average constants were obtained rigorously from petrofabric data using published values of olivine single-crystal constants. These constants were used to calculate P- and S-wave phase velocities in various directions for comparison with actual measurements made in the same specimens. Agreement between the predicted and observed velocities was within the observational error for compressional waves when using the Voight scheme, with best agreement at pressures above 2 kb. The Reuss scheme also predicts the variation in velocity with direction quite well. Agreement of shear wave velocities is not so good. The data suggest that the anisotropy of crystalline aggregates at hydrostatic pressures above a few kilobars is governed almost exclusively by crystal orientation. — *from* Authors' abstract

06944 **Crosson, Robert S.; Peters, David C.** Crustal structure inversion of local array data [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 530, 1970.

Curl, Herbert. *See* Pak, Hasong. 06727

07050 **Currie, K. L.; Ferguson, J.** The mechanism of intrusion of lamprophyre dikes indicated by "offsetting" of dikes: Tectonophysics, v. 9, no. 6, p. 525-535, illus., table, 1970.

The length to width ratio of magmatic bodies is controlled by their viscosity, rate of intrusion, dimensions and the stress conditions in the host rocks. For bodies less than 10 cm wide the length to width ratio of an ordinary dry magmatic dike cannot exceed 200. If the magma is saturated or supersaturated with water; however, boiling off the water during intrusion causes a low viscosity precursor of the magma which greatly facilitates intrusion. This process can be repeated several times. Evidence of the action of precursor is preserved in the form of non-faulted offsets in the dikes with thin projections of the dike crossing the line of offset. Examples, which are common in water saturated dikes such as lamprophyres, are described and figured [dike swarm associated with carbonatite complex at Callander Bay, Ontario]. — Authors' abstract

06712 **Curtis, Doris Malkin.** Miocene deltaic sedimentation, Louisiana Gulf Coast, *in* Deltaic sedimentation, modern and ancient: Soc. Econ. Paleontologists and Mineralogists Spec. Pub. 15, p. 293-308, illus., 1970.

Miocene deltas and delta complexes of south Louisiana differ from each other in shape, distribution, and three-dimensional geometry. Such distinctions in morphology and temporal and spatial interrelations of sedimentation and gravity tectonics are explained in terms of a conceptual model of a paralic basin in which rates of deposition and rates of subsidence vary. If rate of deposition exceeds rate of subsidence, deltas prograde, and normal regressive basin-filling sedimentation results. Initiation of slump faulting and associated uplift of low-density materials is contemporaneous with prograding of a younger delta beyond the distal end of an older one. If rate of deposition equals rate of subsidence, deltas build vertically and spread laterally, but if less than rate of subsidence, regional transgression results. Examples from south Louisiana Miocene, could be used as analogs for interpreting less well-known ancient delta complexes. — *from* Author's abstract

06945 **Czamanske, Gerald K.; Wones, David R.** Amphiboles as indicators of oxidation during magmatic differentiation [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 531, 1970.

06592 **Dahl, Hilbert Douglas.** A finite element model for anisotropic yielding in gravity loaded rock [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 718B-719B, 1970.

06832 **Dalziel, I. W. D.; Dott, R. H., Jr.** Geology of the Baraboo district, Wisconsin — A description and field guide incorporating structural analysis of the Precambrian rocks and sedimentologic studies of the Paleozoic strata, *with summaries*. . . by R. F. Black and J. H. Zimmerman: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 14, 164 p., illus., tables, geol. maps, 1970.

Precambrian inliers along the Wisconsin Arch axis are best known in Columbia and Sauk Counties as Baraboo Ranges; they are monadnocks of massive pink, maroon, or purple-colored quartzite, the source of spectacular basal conglomerates in unconformably overlying Cambrian and Ordovician strata. Rock ages and relations in the Precambrian succession, folded into a complex doubly-plunging, asymmetric syncline that dips steeply NNW, sedimentology of the Baraboo Quartzite, and mesoscopic structures are discussed. Paleozoic stratigraphy is summarized, and Cambrian sedimentology, crossbedding, and paleogeography are treated in detail with stereoplots and sketches. Sedimentary and structural features are pointed out in the road log and guide to supplementary stops. A synthesized geologic map is in pocket with cross sections, structure maps, conglomerate-size data, and crossbedding orientations. — GDC

06946 **Damberger, Heinz H.** Coalification patterns of Pennsylvanian coal basins of the U.S.A. [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 532, 1970.

Daniels, R. B. *See* Touchet, B. A. 07041

06947 **Davis, Margaret B.** Erosion rates and land use history in southern Michigan [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 533, 1970.

Davis, N. F. *See* Burnham, C. Wayne. 00188

06948 **Davis, Richard A., Jr.** Sedimentation in beach and nearshore environments of eastern Lake Michigan [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 533-534, 1970.

06949 **Davis, Richard A., Jr.; Fox, William T.** Sediments, processes, and topography in the nearshore environment [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 534, 1970.

00144 **Davis, Stanley N.** Discussion of paper by Walter E. Reed, "Transport of water away from a buried heat source with special reference to hydrologic phenomena observed at Aardvark nuclear detonation" (1970): Jour. Geophys. Research, v. 76, no. 2, p. 630-632, 1971.

For original paper, *see* ibid., v. 75, no. 2, p. 415-430, 1970; Abs. North American Geology, June 1970.

06677 **Davis, W. M.** River terraces in New England, [Chap.] 2 *in* Rivers and river terraces (G. H. Dury, editor): London, Macmillan and Co. Ltd., p. 36-72, illus., condensed 1970, originally published 1902.

The origin of river terraces in New England is summarized. Diminution of stream volume may have taken place, but was not essential. Terracing rivers have slowly degraded their aggraded valleys while swinging from side to side in response to a northern uplift and gradual decrease in load, and in spite of a probable decrease in volume. Encounters with rock ledges by the swinging river are the chief cause of diminution of interscarp space and preservation of terraces. The behavior of a wandering river is discussed and terminology summarized and extended. The ideal ter-

race pattern and defended terrace cusps are described in the early, middle, and late stages. Observations of river terraces in New England include: Westfield and Little River valleys, Mass., and Saxtons River, Vt., and the Connecticut River below Bellows and Turners Falls, Vt. The full paper was published in Harvard Univ. Mus. Comp. Zoology Bull. 38. — ESL

06950 **Dawson, James Clifford.** The sedimentology and stratigraphy of the Morrison Formation (Upper Jurassic) in northwestern Colorado and northeastern Utah [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 534-535, 1970.

06951 **Day, Howard W.** Redetermination of the stability of muscovite + quartz [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 535, 1970.

06714 **Day, Michael H.** Fossil man: New York, Grosset and Dunlap, 159 p., illus., 1970.

This popular account contains sections on: rise of the primates (classification of man, spread of primates, modern primates); Pleistocene period (climate and land mammals); fossils, the dating of man (fossil bones, laboratory work, dating of man, absolute dating); structure of man (bone structure and an anatomical interpretation); prehuman phase; early human phase; modern human phase; evolution of culture (stony tools, Paleolithic tools, metal tools); and origin of man (summary of evolutionary changes). – MCM

06952 **Dean, Walter E., Jr.** A module system of instruction for introductory earth science courses [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 535-536, 1970.

06802 **DeBruin, Richard.** 100 topographic maps illustrating physiographic features: Northbrook, Ill., Hubbard Press, 128 p., illus., 1970.

This laboratory manual represents a condensation of maps of the U.S. Geological Survey to depict major physiographic features of the continental United States for use in teaching earth science, geography, social studies, geology, and topography. — MCM

Deer, W. A. *See* Kempe, D. R. C. 07059

Defleur-Schenus, Murici. *See* Jedwab, Jacques. 06518

Demarest, Harold H., Jr. *See* Anderson, Orson L. 00131

DeMatteo, John J. *See* Butera, Anthony W. 06704

06791 **Dennison, J. M.; Textoris, D. A.** Devonian Tioga tuff in northeastern United States: Bull. Volcanol., v. 34, no. 1, p. 289-294, illus., 1970.

The Tioga Bentonite ranges from a coarse crystal tuff to a tuffaceous shale enclosed in marine strata. It originally was deposited over the entire northeastern United States during the Middle Devonian. Trends in grain size, thickness, and numbers of preserved ash layers indicate a source volcano in west-central or central Virginia. — Authors' abstract

06893 **Desborough, George A.; Sainsbury, C. L.** Cassiterite as an exsolution product in magnetite, Lost River tin mine, Alaska: Econ. Geology, v. 65, no. 8, p. 1004-1006, illus., 1970.

Examination of polished surfaces of magnetite indicates dissemination of cassiterite throughout all magnetite grains in the form of exsolution bodies; electron-probe analyses demonstrate homogeneity of bulk tin content, also evidence for exsolution origin. These results suggest that abundant cassiterite can occur in tin-bearing skarns as an exsolution intergrowth in magnetite, but is probably unrecoverable because of small grain size. Stanniferous magnetite from skarns associated with tin granites concentrated in stream sediments may indicate potentially valuable tin deposits. Possibly during late-stage alteration of granite with introduction of sulfide minerals, tin in

magnetite might be remobilized and moved out to form associated tin deposits, or pyrite may replace primary magnetite and tin as sulfide might be retained. — VSN

06897 **Desborough, George A.; Raymond, William H.; Iagmin, Paula J.** Distribution of silver and copper in placer gold derived from the northeastern part of the Colorado Mineral Belt: Econ. Geology, v. 65, no. 8, p. 937-944, illus., table, 1970.

Placer gold grains from the modern streams originating in the Colorado Mineral Belt were examined for silver and copper content on a quantitative basis utilizing the electron microprobe. The variation among grains from a particular locality is large, but the mean silver content of the interior of the placer gold grains from each locality and (or) the variation in copper content may be of value in distinguishing lode sources and gold mining districts. Microprobe analysis of the interior of gold grains is independent of chemical actions that effect the border of placer gold grains during their transport history, and it is shown that distinct compositional groups of different lode sources may be identified even in a single sample — information that may aid in recognizing the existence of concealed lodes that once contributed to a placer environment. — Authors' abstract

Deuser, W. G. *See* Kroopnick, P. 06760

06774 **Dezfulian, Houshang; Seed, H. Bolton.** Seismic response of soil deposits underlain by sloping rock boundaries: Am. Soc. Civil Engineers Proc., v. 96, paper 7659, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 1893-1916, illus., tables, 1970.

The finite element method of analysis provides a powerful tool for analyzing the response of soil deposits underlain by sloping rock boundaries; however, the mode superposition procedure for applying this analysis does not take into account variability in damping ratio associated with different regions of a soil deposit. Procedures are described which attempt to compensate for this shortcoming. Analytical results show influence of inclination of the rock surface, thickness of the soil deposit, and its configuration on the ground surface response for a range of soil types. While magntitude of the surface response in the vicinity of a sloping rock surface may be significantly influenced by pressure of the slope, the frequency characteristics are only slightly affected. Conclusions indicate effects of sloping rock surfaces on the directional ground surface accelerations in adjacent soil deposits. — *from* ASCE abstract

06953 **Dickas, Albert B.** Depositional environments of western Lake Superior sands through grain size analysis [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 536-537, 1970.

06954 **Dimroth, Erich.** The ophiolite complex of the Labrador geosyncline and global tectonics [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 538, 1970.

DiScala, L. *See* Viramonte, J. G. 06793

06955 **Doe, B. R.; Christiansen, R. L.; Hedge, C. E.** Radiogenic tracers and the basalt-rhyolite association, Yellowstone National Park and vicinity [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 538-539, 1970.

06956 **Doehring, Donald O.; Vierbuchen, Richard C.** Cave development during a catastrophic flood in the Great Valley of Virginia [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 539, 1970.

06647 **Dohler, G.** Tide-gauge data telemetry between the tsunami warning center at Honolulu, Hawaii and selected stations in Canada, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 191-206, illus., 1970.

The resolution on the international aspects of the Tsunami Warning System in the Pacific, as adopted during the fourth session of the Intergovernmental Oceanographic Commission, indicated the importance of providing timely warnings of the

approach of tsunamis. In 1966, Canada, realizing the importance of such timely warnings, installed equipment capable of reporting, unattended and automatically, water-level data of significance to the Tsunami Warning Center. — Author's abstract

06865 **Dolcater, David Lee.** Cation exchange selectivity and mineralogy of soil clay materials [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 18B, 1970.

06584 **Dole, Robert Malcolm, Jr.** Postglacial vegetation of northern Vermont [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 543B, 1970.

Dolence, J. D. *See* Mancuso, J. D. 06485

06701 **Dollase, W. A.** Least-squares refinement of the structure of a plutonic nepheline [with German abs.]: Zeitschr. Kristallographie, v. 132, nos. 1-2, p. 27-44, illus., tables, 1970.

This paper reports refinement of new three-dimensional intensity data (739 reflections) measured by single-crystal diffractometry on a nepheline specimen from Larvik, Norway. Refinement in the true space group, $P6_3$, led to such high estimated standard errors that details of structure could not be established. A model was refined in which all parameters were constrained to centric symmetry, except those few which showed significant deviation from a centric model. This constrained $P6_3$ model yielded $R = 7.3$ percent and satisfactory parameter-error estimates; an intermediate degree of ordering of Si-Al atoms on the four available tetrahedral positions is suggested. A model is presented which rationalizes the observed O(1) positional disorder, the extent of the common solid solution where Si replaces Al, and probable location of so-called excess Si in the structure. — *from* Author's abstract

06748 **Donaldson, Alan C.; Martin, Richard H.; Kanes, William H.** Holocene Guadalupe delta of Texas Gulf Coast, *in* Deltaic sedimentation, modern and ancient: Soc. Econ. Paleontologists and Mineralogists Spec. Pub. 15, p. 107-137, illus., tables, 1970.

The delta of Guadalupe River is prograding into San Antonio Bay along a shoreline dominated by barrier islands. The load deposited in relatively quiet water, progrades into increasingly shallow water. Sediments are recognized from six environments: distributary channel, natural levee, marsh, interdistributary bay, delta front, and prodelta. Overall configuration is birdfoot with occasional small lobate masses where the delta has prograded toward shallower margins. No species of fauna is confined to a particular environment; subdivision into biofacies is based on diversity and abundance of fauna, mainly Mollusca. Rate of progradation varies in response to depth of water, and the stable tectonic setting accounts for slight overlap of subdeltas. Characteristics which make this delta a distinctive model for application to ancient deltaic sediments and environments are enumerated. — VSN

Donaldson, J. Roger. *See* Hacquebard, Peter A. 07001

06513 **Donnay, Gabrielle; Allmann, Rudolf.** How to recognize O^{2-}, OH^-, and H_2O in crystal structures determined by X-rays: Am. Mineralogist, v. 55, nos. 5-6, p. 1003-1015, illus., tables, 1970.

It happens frequently that the chemical analysis of a new mineral does not distinguish hydroxyl groups from water molecules incorporated in the crystal structure. The problem can be solved by Pauling's principle of local neutralization of charge. A double-entry table of cation-to-anion bond lengths and associated bond valences leads to valence sums for the oxygen anions. Such a sum is approximately equal to 2 for an oxygen ion, 1 for a hydroxyl ion, and 0 for a water molecule. The deviation from the integral value gives information about hydrogen bonding. An empirical curve expresses bond valences in terms of bond length; it is based on two equations which are given. The procedure is applied to sonoraite, grunerite, and bultfonteinite. — JWC

06515 **Donnay, Gabrielle; Fleischer, Michael.** Suggested outline for new mineral descriptions: Am. Mineralogist, v. 55, nos. 5-6, p. 1017-1019, 1970.

07106 **Doonan, C. J.; Hendrickson, G. E.; Byerlay, J. R.** Ground water and geology of Keweenaw Peninsula, Michigan: Michigan Geol. Survey Water Inv. 10, 40 p., illus., tables, geol. map, 1970.

Most wells in Houghton and Keweenaw Counties yield only enough water for a domestic supply, but a few yield several hundred gpm. Bedrock aquifers supply most of the wells in Keweenaw County and about half the wells in Houghton County; other wells are supplied by glacial aquifers — chiefly beds of sand and gravel in lakebeds and morainal deposits. All wells yielding more than 100 gpm are in glacial deposits. Water from most wells is satisfactory for domestic use, but many wells produce water with troublesome amounts of iron. Water too salty for drinking is obtained from a few of the deeper bedrock wells. Most public supplies are obtained from wells and springs, but some are from Lake Superior or from mine shafts. — *from* Authors' abstract

06804 **Dorheim, Fred H.** Mineral resources of Iowa: Iowa City, Iowa, Iowa Geol. Survey, scale 1:500,000, text, 1970.

The text covers cement materials, clay-shale, coal, gypsum, limestone and dolomite, sand and gravel, sandstone, underground gas storage, and ground water. — MCM

06957 **Dorman, LeRoy M.; Sacks, I. Selwyn; Evertson, Dale.** Atmospherically induced earth strain noise in borehole strainmeters in the period range 20-3000 seconds [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 540, 1970.

06958 **Dorman, LeRoy M.; Lewis, Brian T. R.** Correlation of seismic and gravity data with upper mantle properties [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 540-541, 1970.

Dott, R. H., Jr. *See* Dalziel, I. W. D. 06832

00170 **Downey, Joe S.** Ground-water resources of Walsh County, northeastern North Dakota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-431, scale 1:126,720, text, 1971.

Principal aquifers in Walsh County are glaciofluvial deposits which range from about 300 feet in the eastern part to about 30 feet in the western; yields to wells range from 50 to more than 500 gpm. Several less productive aquifers are associated with various glacial features which have short-term yields up to 50 gpm. It appears that moderate to large yields would be available locally from Pierre Shale and Dakota Sandstone. Chemical quality of water varies widely. — MCM

06959 **Dowty, Eric; Appleman, D. E.** X-ray refinement and Mössbauer study of Ti-Zr garnets, tetrahedral Fe^{2+}, [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 541, 1970.

06918 **Drake, Charles L.** The geological revolution: Eugene, Oreg., Oregon State System of Higher Education (Condon lectures), 55 p., illus., 1970.

Collaborating geophysicists, paleontologists, oceanographers, stratigraphers, volcanologists, and structural geologists have produced a flood of new ideas concerning internal processes of the Earth, including sudden reversal from assumed stable oceans and unstable continents to spreading sea-floors and crustal plate movements. Revolutionary concepts of global tectonics extending over millions of years have been proposed and coordinated in international programs. The Upper Mantle Project concentrated on crustal depth of 700 km in the active zone of earthquakes that rims the Pacific; Atlantic margins are relatively inactive. Over the world, large geosynclinal basins stratigraphically record many vertical movements apparently unrelated to sea-floor spreading. Lavas of the Cascades, the sedimentary Coast Ranges, and granites in the Sierra Nevada show response to it. — GDC

07087 **Drake, Gerald.** Experimental study of quartz growth [abs.]: West Virginia Acad. Sci. Proc. 1969, v. 41 (West Virginia Univ. Bull., ser. 70, no. 11-3), p. 188, 1970.

06844 **Drake, M. J.; McCallum, I. S.; McKay, G. A.; Weill, D. F.** Mineralogy and petrology of Apollo 12 sample no. 12013 — A progress report: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 103-123, illus., tables, 1970.

A mineralogical-petrological survey of Apollo 12 sample 12013 has been made with petrographic microscope and electron microprobe. The rock is extremely homogeneous and consists of at least two separate fragmental units (light and dark) permeated by a once-fluid granitic component. The fragmental material includes a wide variety of lithic and crystal fragments some of which have not yet been reported from other lunar samples. The granitic component is essentially bimineralic, with dominant potassic feldspar plus silica. — Authors' abstract

06960 **Dreimanis, Aleksis; Goldthwait, Richard P.** Wisconsin glaciation in the Huron, Erie and Ontario lobal areas [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 541-542, 1970.

06961 **Drever, James I.** Magnesium removal from sea water by diagenesis in a reducing environment [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 542, 1970.

06962 **Dreyer, Robert M.** Fifty years of industrial minerals [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 542-543, 1970; Econ. Geology, v. 65, no. 6, p. 736-737, 1970.

06963 **Duke, M. B.; Sellers, G. A.; Woo, C. C.; Bird, M. L.** Genesis of lunar fines [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 543, 1970.

07090 **Duncan, William M.; Eddy, Greg E.; Jones, Michael L.; Williamson, Douglas B.** An igneous dike in Pendleton County, West Virginia: West Virginia Acad. Sci. Proc. 1969, v. 41 (West Virginia Univ. Bull., ser. 70, no. 11-3), p. 197-200, illus., 1970.

A zone of closely spaced parallel igneous dikes was discovered in a Helderberg limestone cave in Pendleton County, West Virginia. Individual dikes range in thickness from a fraction of an inch to several inches and occupy a zone 70 feet wide. The dikes, although not located with certainty on the surface, appear to be mineralogically similar to previously mapped dikes in the area. Differences are attributed to differences in weathering on the surface and in the cave. The dikes control the size, shape, and orientation of intersecting cave passages. — Authors' abstract

06754 **Dunn, Darrel E.** The probability of anomalies on contour maps: Ground Water, v. 8, no. 6, p. 33-38, illus., tables, 1970.

The minimum probability that anomalous bulges and re-entrants produced by mechanical (as opposed to interpretational) contouring of data on maps actually exist and are not merely the result of measurement errors may be calculated. The calculation consists of computing the compound probability that the value of at least one data point within each anomaly is actually higher or lower than the value of one data point on each flank of the anomaly. The calculation requires multiple data values at one or more locations on the map or a subjective estimate of the variance of the data. It is assumed that the variance of the data does not change from place to place on the map and that the recorded data values are normally distributed about the true value. — Author's abstract

06757 **Duquette, Gilles; Mathieu, Arthur.** Preliminary report on the south half of Obalski Township, Abitibi East County [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 585, 17 p., tables, geol. maps, 1970.

This area, mapped at 1 in to 1,000 feet, straddles the south end of Chibougamau Lake. Except for an olivine diabase dike and a Proterozoic, conglomerate outlier, the rocks are Archean, of the Lac Dore Complex or Lac Chibougamau Pluton. The older complex is in limbs of a regional anticline crossing ENE the northern part of the area: in north limb, three stratiform units — Nos. 1 and 2, varying anorthositic metagab-

bros, and No. 3, titaniferous magnetite-rich metapyroxenite; in south limb, rocks similar to Unit 1, except for a pyroxenite band in southwest corner. The Pluton, a zoned diorite-tonalite complex covering two-thirds of the area, is believed to be a laccolith that intruded at base of the Lac Dore before Kenoran folding. Boulders in the conglomerate include facies of these complexes. Analyses of Cu, Zn, Pb, Mo, Ni, and U, in sampled boulders and quartz vein zones, are tabulated. — GDC

06535 **Dury, G. H.** (editor). Rivers and river terraces: London, Macmillan and Co. Ltd., 283 p., illus., tables, 1970.

The nine papers composing this anthology are intended to illustrate some of the directions taken by studies of fluvial morphology; all but one are cited separately. The papers, extracts of earlier works, cover an age range from 1877 to the present; the influence of some of the earlier research can be traced in later work. The reasons for inclusion of each paper and their relation to each other are reviewed. — ESL

06682 **Dury, G. H.** General theory of meandering valleys and underfit streams, [Chap.] 9 *in* Rivers and river terraces (G. H. Dury, editor): London, Macmillan and Co. Ltd., p. 264-275, illus., condensed 1970; originally published 1964-65.

Numbers of meandering valleys contain flood plains on which present-day rivers describe free meanders far less ample than enclosing valley bends. These streams are underfit, implying that valley windings are meanders of former large streams, and that stream and meander size have been reduced. It appears that the required explanation must be climatic. The channel pattern of the Osage River in the Ozarks varies so strongly from that of manifest underfits that it is given a subclassification, underfits of Osage type. Temporal relations of underfit streams have two main aspects: date of origin of rivers, and date of the shrinkage which reduced them. Chronology for some European streams and the southern Atlantic Coastal Plain is reviewed. Two periods of shrinkage are indicated. The original paper was published as U.S. Geol. Survey Prof. Papers 452-A, B, C, 1964-65. — ESL

06964 **Dutcher, Russell R.; Crelling, John C.; Podwysocki, Melvin H.** Thermal alteration of coals and coal materials [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 543-544, 1970.

07080 **Dutro, J. Thomas, Jr.** Pre-Carboniferous carbonate rocks, northeastern Alaska, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. M1-M8, illus., discussion, 1970.

The pre-Carboniferous sequences of the Shublik and Sadlerochit Mts. in northeastern Alaska are discussed, and two new carbonate-rock formations are named (Nanook Limestone and Katakturuk Dolomite). The formations are described, and on the basis of its fauna, the Nanook is placed in Middle Devonian. No fossils were found in the Katakturuk Dolomite in the Shublik Mts.; a collection of *Amphipora* from probable Katakturuk in the Sadlerochit Mts. places it in Devonian, but the fact that the general sequence is unlike any other reported from the Devonian in nearby regions indicates possibilities for a pre-Devonian age, possibly Silurian or even Cambrian. A tentative geologic history is outlined and problems to be answered in the future are listed. — VSN

Eaton, J. P. *See* Richter, D. H. 06692

07089 **Eddy, Greg E.** The Geologic Data System of the West Virginia Geological and Economic Survey: West Virginia Acad. Sci. Proc. 1969, v. 41 (West Virginia Univ. Bull., ser. 70, no. 11-3), p. 194-196, 1970.

A Geologic Data Section was established at the West Virginia Geological and Economic Survey to put into a more usable form the records and information accumulated over the 70-year span of the Survey. The Geologic Data System employed is in three phases: (1) microfilming of geologic records so that they may be stored, recovered and copied; (2) transcribing much of the data for storage and retrieval by

computer; (3) assembling a library of computer programs to retrieve and use the data. author's abstract

Eddy, Greg E. *See* Duncan, William M. 07090

06917 **Edmond, John M.; Gieskes, J. M. T. M.** On the calculation of the degree of saturation of sea water with respect to calcium carbonate under *in situ* conditions: Geochim. et Cosmochim. Acta, v. 34, no. 12, p. 1261-1291, illus., tables, 1970.

A discussion is presented of the computation of the *in situ* degree of saturation of sea water with respect to calcite or aragonite, Ω, using apparent thermodynamic constants. It is found that when the various reported values of the constants are recomputed as to be strictly comparable the resulting concordance is generally good. A systematic error in Ω of not more than 10 percent is estimated to result from the uncertainties in the constants. This is equivalent to an error of 1 percent in the measured values of A_t or ΣCO_2. A profile of A_t and ΣCO_2 from the Brazil Basin in the equatorial South Atlantic is used as an example of the computation procedure. — Authors' abstract

Edmond, John M. *See* Gieskes, Joris M. 06989

06965 **Eggler, David H.** Water-saturated and undersaturated melting relations in two natural andesites [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 544, 1970.

Ehmann, W. D. *See* Morgan, J. W. 06847

Eifler, Gus K., Jr. *See* Brown, L. F., Jr. 07039

06966 **Eimon, Paul I.** Fifty years, worldwide porphyry copper discoveries [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 544-545, 1970; Econ. Geology, v. 65, no. 6, p. 737, 1970.

06516 **Einaudi, Marco T.** An iron-sensitive stain for iron-rich sphalerite: Am. Mineralogist, v. 55, nos. 5-6, p. 1048-1054, illus., table, 1970.

An ammonium dichromate-hydrochloric acid solution serves as an iron-sensitive stain on polished surfaces of iron-rich sphalerite. — Author's abstract

06967 **Elders, Wilfred A.; Meidav, Tsvi; Rex, Robert W.; Robinson, Paul T.** The Imperial Valley of California, the product of oceanic spreading centers acting on a continent [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 545, 1970.

00116 **Elsasser, Walter M.** Sea-floor spreading as thermal convection: Jour. Geophys. Research, v. 76, no. 5, p. 1101-1112, illus., 1971.

The basis of this theoretical paper is the assumption that the asthenosphere is "soft' enough so that it does not transmit significant horizontal shear stress to the overlying lithosphere. Any thermal mantle convection is likely to originate in cooling of the top layers of the oceanic mantle. There is geological evidence for the existence of regions that exhibit wide-spread horizontal tension. Submarine ridges can be considered as regions of horizontal tensile stress. The mechanism of generation of such stresses which is found to be satisfactory qualitatively and quantitatively arises through the disappearance of pieces of lithosphere, which slide down along the Gutenberg-Benioff fault zones. The lithosphere spreads to fill the gaps created. This motion is likely to represent the surficial part of thermally driven convective circulation in the mantle. The nature of the "return flow" farther down is discussed. — *from* Author's abstract

06969 **Emerson, John W.** Consequences of artificial stream channel alteration, Johnson County, Missouri [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 547, 1970.

06970 **Engdahl, E. R.; Tarr, A. C.** Seismicity of the Amchitka Island region [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 547, 1970.

Engelhardt, Donald W. *See* Hedlund, Richard W. 07056

Eppley, R. A. *See* Murphy, L. M. 06650

Epstein, Samuel. *See* Taylor, Hugh P., Jr. 06853

06477 **Ermanovics, I. F.** A model for tectonic variation of 'granitic terrain' in southeastern Manitoba [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 16, 1970.

06763 **Escher, A.; Escher, J.; Watterson, J.** The Nagssugtoqidian boundary and the deformation of the Kangamiut dyke swarm in the Söndre Strömfjord area, *in* Report of activities, 1969: Grönlands Geol. Undersögelse Rap. 28, p. 21-23, 1970.

The Nagssugtoqidian boundary has a NE-SW strike. To the south are quartzitic granulite facies gneisses, agmatite layers, and eastern Rapakivi-type granite massifs; Evigheds Fjord gneisses, in flattened shear zones with pseudotrachylite breccias, are retrogressed. Post-dating all these, the wide Kangâmiut dike swarm cuts at 70° a less dense swarm; most are dolerites, a few composite with leucogabbro cores, and some garnet-amphibolite centered restricted to shear zones. In the boundary zone mineral changes relate to structure. To the north, gneiss foliation and dikes are mostly concordant, the reoriented Kangâmiut swarm is a fifth of its original width; where both dikes and gneisses have granulite facies is the metamorphic boundary, a thrust zone dipping NW; two small supracrustal areas are cut by Kangâmiut dikes; much younger ultrabasic dikes and veins may include kimberlite. — GDC

Escher, J. *See* Escher, A. 06763

Eschman, Donald F. *See* Ferrand, William R. 06975

06971 **Essene, Eric; Ware, N. G.** The low temperature xenolithic origin of eclogites in diatremes, N.E. Arizona [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 547-548, 1970.

06972 **Evans, Howard T., Jr.; Staples, Lloyd W.** The crystal structure of cavansite, a novel layer silicate [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 548, 1970.

06822 **Evans, M. E.; Wayman, M. L.** An investigation of small magnetic particles by means of electron microscopy: Earth and Planetary Sci. Letters, v. 9, no. 4, p. 365-370, illus., 1970.

The size distribution of magnetite grains in a basic igneous intrusion has been investigated by means of electron microscopy. The distribution was found to peak at about 1/4 μm and to extend well into the "submicroscopic" region. Many of the smaller particles observed are expected on theoretical grounds to be single domain grains, and these undoubtedly make a significant contribution to the stable thermoremanent magnetization. — Authors' abstract

00114 **Everett, K. R.** Composition and genesis of the organic soils of Amchitka Island, Aleutian Islands, Alaska: Arctic and Alpine Research, v. 3, no. 1, p. 1-16, illus., tables, 1971.

Amchitka Island, in the western Aleutian chain, supports a nearly unbroken cover of organic soils over 75 percent of its area. Four organic types are recognized, based largely upon differences in relative amounts of peat in the three decomposition states recognized, field moisture, and bulk density. To a lesser degree differentiation is based on thin-section characteristics and selected chemical parameters. Soils are arranged toposequentially from thick, raw fibrous peat of low, very poorly drained

areas to thinner sequences of very highly decomposed (Sapric) organic matter on better drained steep slopes and near-crest positions. Organic soil morphology and radiocarbon dating suggest the organic blanket began to accumulate some 10,550 yr B.P., at the end of the Late Glacial, in a climate slightly drier and cooler than present. Within at least the last 9,000 years a rather abrupt shift to moister conditions occurred with accumulation of much of the present organic cover. — *from* Author's abstract

Evertson, Dale. *See* Dorman, LeRoy M. 06957

06973 **Fahnestock, Robert K.** Channel form, pattern, and activity of gravel-bearing streams [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 548-549, 1970.

Faller, J. *See* Boyne, H. S. 06627

06974 **Fang, Jen-Ho; Robinson, Paul D.** Polytypism of coquimbite and paracoquimbite [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 549, 1970.

Farnham, Paul R. *See* Mooney, Harold M. 06582

06631 **Faye, G. H.; Nickel, E. H.** The effect of charge-transfer processes on the colour and pleochroism of amphiboles: Canadian Mineralogist, v. 10, pt. 4, p. 616-635, illus., table, 1970.

A study is reported of the polarized optical absorption spectra of the amphiboles riebeckite, crossite, glaucophane, holmquistite, hornblende, barkevikite and ferrohastingsite. The colour and pleochroism of the amphiboles are primarily the result of the polarization properties of electronic transitions associated with Fe^{2+} approaches Fe^{3+} and O^{2-} approaches Fe^{3+} charge-transfer processes. The former process is an important feature of the spectra of all the amphiboles; however, the latter is more important for calcic amphiboles. It is shown how the charge-transfer processes are thought to be related to the amphibole structure and to cation distribution. The *a-c* sections of most of the monoclinic amphiboles examined show anomalous extinction, which is attributed to the non-coincidence of the principal vibration and absorption directions. — Authors' abstract

06508 **Fedoseev, A. D.; Grigor'eva, L. F.; Chigareva, O. G.; Romanov, D. P.** Synthetic fibrous fluoramphiboles and their properties: Am. Mineralogist, v. 55, nos. 5-6, p. 854-863, illus., tables, 1970.

Asbestiform fluoramphiboles with isomorphous substitutions of cations both in A, M(4), and M(1-3) positions have been synthesized by heating the fluorsilicate mixtures at 900-1100°C under atmospheric pressure. Chemical, optical, and X-ray data show that monoclinic synthetic fluoramphiboles in which Mg is partially substituted by Ni, Co, Zn, Cd, and Fe can be referred to the richterite series. There is a distinct tendency for increasing refractive indexes with increasing electronegativity of the substitute atoms. Some of the physical and chemical properties of the fluoramphiboles were measured. — *from* Authors' abstract

07060 **Ferenčić, Ante.** Porphyry copper mineralization in Panama [with German abs.]: Mineralium Deposita, v. 5, no. 4, p. 383-389, illus., 1970.

Recently discovered porphyry copper mineralization at Petaquilla in Panama covers an area of 8-10 sq km (about 4 sq km possibly economic). Some 20 ore minerals with chalcopyrite prevailing constitute the mineral association. The mineralization is related to the late Tertiary intermediate intrusives. Geochemical surveys played an important role in the determination of ore-bearing areas. The possible economic importance of these deposits is being investigated. — Author's English abstract

07098 **Ferguson, Carl C.; Milici, Robert C.** Geologic map of the Bald Knob quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 332-SW, scale 1:24,000, separate text, 1970.

The only mineral resource mined in the Bald Knob quadrangle is limestone from the Monteagle, St. Louis, and Bangor formations. Potential resources are shale, chert, sand, and sandstone. — MCM

Ferguson, J. *See* Currie, K. L. 07050

06709 **Ferm, John C.** Allegheny deltaic deposits, *in* Deltaic sedimentation, modern and ancient: Soc. Econ. Paleontologists and Mineralogists Spec. Pub. 15, p. 246-255, illus., 1970.

Results of Recent delta studies provide a lithogenetic model applicable to Middle Pennsylvanian rocks of the northern Appalachian Plateau. The model is a three-dimensional lenticular body, mainly of detrital rocks which grade upward and landward from clays to sand as a result of deltaic progradation. Detrital sediments are completely or partially enclosed in a veneer of chemically precipitated or indigenously formed peats (coals), root-penetrated clays or carbonate sediments which were deposited on the offshore front, or on marginal portions of the delta, or accumulated on the delta-plain surface when it no longer received appreciable detrital influx. Lateral shift of sites of major detrital deposition, a phenomenon common in Recent deltas, results in an en echelon arrangement of progradational detrital wedges, a distinctive feature of ancient Appalachian sediments. — *from* Author's abstract

06975 **Ferrand, William R.; Eschman, Donald F.** New facts concerning the glacial Grand Valley [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 549-550, 1970.

00184 **Feulner, Alvin J.** Water-resources reconnaissance of a part of the Matanuska-Susitna Borough, Alaska: U.S. Geol. Survey Hydrol. Inv. Atlas HA-364, scale 1:250,000, text, 1971.

The study area of the Matanuska-Susitna Borough is divided into three units on the basis of geologic and hydrologic data and on analogy with similar areas for which more definitive data are available. Unit 1 contains no communities, few residences, and no known wells; yields of less than 10 gpm probably can be developed in limited surface deposits or from fractured zones in underlying bedrock. Unit 2, the most heavily populated area, is underlain mainly by glacial deposits although outwash and alluvial deposits occur near streams; yields of wells range from 10 to 50 gpm and there is little potential for development. Unit 3, which includes flood plains and lowland areas adjacent to streams and rivers, is underlain by glacial and alluvial deposits of sand and gravel where wells yield more than 100 gpm; this area offers the greatest possibility for development. Ground water has a greater chemical quality variation than surface water. — MCM

Fielder, Gilbert. *See* Strom, Robert G. 06857

06554 **Filby, R. H.; Haller, W. A.; Shah, K. R.** Determination of 32 elements in rocks by neutron activation analysis and high resolution gamma-ray spectroscopy: Jour. Radioanal. Chemistry, v. 5, no. 2, p. 277-289, illus., tables, 1970.

Neutron activation analysis and Ge(Li) spectroscopy was used to determine 32 elements in seven U.S.G.S. standard rocks of a wide range of composition. Short half-life nuclides (10 sec — 10 min) were used to measure Sc, Hf, Dy, Mg, Al, Ca, Ti, V (and Na) in an automated rabbit Ge(Li) detector system. The elements K, Cu, Zn, Ga, Sr, Ba, La, Eu, Sm, (and Mn) were determined by dissolution of the irradiated sample followed by removal of Na-24 on hydrated antimony pentoxide (HAP). Long-lived nuclides were used to measure Sc, Cr, Fe, Co, Zr, Rb, Sb, Cs, Ba, Ce, Eu, Yb, Tb, Lu, Hf, Ta, and Th after decay of Na-24. The method involves little radiochemistry and the separation is selective for Na-24 under experimental conditions used. Elemental concentrations determined agree well with previously published data. — Authors' abstract

06648 **Filloux, J. H.** Bourdon-tube, deep-sea tide gauges, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii,

1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 223-238, illus., table, 1970.

Multiturn Bourdon tubes are remarkable pressure transducers originally intended to detect, on the sea floor, the pressure signature associated with the passage of a tsunami. So far they have been used only to record tidal fluctuations on the open ocean. This paper reviews the main mechanisms that contribute to the temperature dependence of an ordinary Bourdon tube. From this, the manner in which such a pressure transducer can be optimized is deduced. The optical readout scheme that satisfies the requirements (very sensitive and frictionless) is described. Finally, a deep-sea tide record is examined to provide an idea of the performances achieved. — DBV

06976 **Finger, Larry W.; Taylor, Lawrence A.** Refinement of the crystal structure of mackinawite [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 551, 19 70.

06773 **Finn, W. D. Liam; Bransby, Peter L.; Pickering, Dennison J.** Effect of strain history of liquefaction of sand: Am. Soc. Civil Engineers Proc., v. 96, paper 7670, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 1917-1934, illus., 1970.

Resistance of a saturated sand to liquefaction under cyclic loading has been assumed to depend only on void ratio, effective stress system, and intensity of cyclic loading. The effect of strain history on resistance to liquefaction is investigated here by triaxial and simple shear tests. In laboratory tests, resistence of saturated sand to liquefaction is very much influenced by previous strain history. Partial liquefaction which occurs at small shear strains greatly increases resistance to liquefaction in subsequent tests. Cycles of large shear strains, or quasi-static shear strains > 7.5 percent, reduce resistance to liquefaction. Increase in resistance created by a very small shear strain may result from elimination of small instabilities in the original sand structure, and loss caused by larger shear strains may be due to creation of a uniform metastable structure or to development of a non-uniform structue. — *from* ASCE abstract

06500 **Finney, J. J.; Kumbasar, Isik; Konnert, Judith A.; Clark, Joan R.** Crystal structure of the calcium silicoborate, howlite: Am. Mineralogist, v. 55, nos. 5-6, p. 716-728, illus., tables, 1970.

Using the 1500 hkl intensities estimated visually from Weissenberg photographs, the structure of howlite was determined by locating the Ca atoms from a Patterson synthesis and placing the oxygen, boron, and silicon atoms following study of a three-dimensional electron-density map based on the Ca signs. That boron occurs in both tetrahedral and triangular coordination is verified because the structure contains colemanite-like chains with two tetrahedra and a triangle. These chains are located on the edges of anion slabs which contain spirals of silicate plus borate tetrahedra in the central region between chains. The slabs are held tightly together by single and double chains of Ca coordination polyhedra. The absence of any cleavage is in accord with the structural character. — *from* Authors' abstract

06977 **Fischer, Joseph A.; Leeds, David J.; Murphy, William J.** Seismic-tectonic relationships of the New Madrid, Missouri, region [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 551, 1970.

07043 **Fisher, Irving S.** Origin of small irregular dolomite bodies in the pelletal Camp Nelson Limestone (Ordovician) of central Kentucky: Southeastern Geology, v. 12, no. 2, p. 115-120, illus., 1970.

The initial stage of dolomitization of the Ordovician Camp Nelson Limestone was localized within permeable zones formed by late burrowing activity plus the permeability associated with concentrations of skeleton fragments in a biopelmicrite. Dolomite formation followed sparry calcite crack filling and preceded induration of the rock. — Author's abstract

Flach, K. W. *See* Nettleton, W. D. 07063

06978 **Fleet, M. E.** The crystal structure of pyrrhotite [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 551-552, 1970.

06514 **Fleischer, Michael.** Procedure of the International Mineralogical Association Commission on New Minerals and Mineral Names: Am. Mineralogist, v. 55, nos. 5-6, p. 1016-1017, 1970.

Fleischer, Michael. *See* Donnay, Gabrielle. 06515

06902 **Flemal, Ronald C.** Post-glacial drainage diversions in a portion of north central Illinois: Illinois Acad. Sci. Trans., v. 63, no. 3, p. 285-294, illus., 1970.

Original drainage in this area, which was consequent on the glacial landscape, has been extensively modified by the capture of low gradient streams by their more dynamic neighbors. Two streams in particular, Indian Creek and Kyte River, have extended their drainage at the expense of their lower gradient neighbors, Green River, South Branch of Kishwaukee River, and Little Vermilion River. — *from* Author's abstract

06680 **Fletcher, Frank W.; Woodrow, Donald L.** Geology and mineral resources of the Pennsylvania portion of the Milford and Port Jervis 15-minute quadrangles: Pennsylvania Geol. Survey, 4th ser., Atlas 223, 64 p., illus., tables, geol. map, 1970.

This report describes bedrock geology of the Pennsylvania parts of Milford and Port Jervis quadrangles. The map area embraces about 195 sq mi in the Appalachian Plateau of northeastern Pennsylvania and is characterized by flat-topped, hummocky hills formed as a result of glaciation and subsequent stream dissection of nearly flat-lying strata. Bedrock consists of sedimentary strata, striking generally N. 35° E. and dipping northwest, from early Middle Devonian (Marcellus Formation) to middle Late Devonian (Lackawaxen Formation) age, and has a total thickness of about 7,300 feet. The lower part of the sequence is dark gray fossiliferous siltstones and shales characterized by ball-and-pillow structures and nodules; the upper part is of medium gray, fine- to coarse grained, crossbedded sandstones and claystones. These beds are plant-bearing and mudcracked. Low-relief, *en echelon* anticlines, high-angle reverse faults, and well-developed, high-angle joints are common structures. — *from* Authors' abstract

06980 **Folk, Robert L.** Evidence of peritidal origin for part of the Caballos novaculite (Devonian radiolarian chert), Marathon Basin, Texas [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 552-553, 1970.

06979 **Foose, Richard M.** Geomorphology and environmental geology [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 552, 1970.

06700 **Foreman, Neil; Peacor, Donald R.** Refinement of the nepheline structure at several temperatures [with German abs.]: Zeitschr. Kristallographie, v. 132, nos. 1-2, p. 45-70, illus., tables, 1970.

The crystal structure of nepheline from a low-temperature environment has been refined with intensities measured at various temperatures. Pre- and post-heat refinements show no irreversible changes in structure. Presence of the "split" oxygen atom detected by Hahn and Buerger (1955) was verified at all temperatures, but there is nearly complete ordering of Al,Si in all four tetrahedral sites. Despite major distortions in the room-temperature structure, coupled with large thermal-expansion coefficients, the geometry of the structure is nearly invariant as a function of temperature. Principal change of structure is an increase in Si-O distances. All evidence is consistent with a lack of change in Al,Si ordering in nephelines formed at different temperatures. A domain structure model is proposed which requires excess of Si relative to Al, and ordered vacancies in K sites. — *from* Authors' abstract

06783 **Forrest, J. B.; MacFarlane, I. C.** Field studies of response of peat to plate loading — Closure [to discussion of paper 6652, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 2130-2131, 1970.

Paper 6652 was published ibid., v. 96, no. SM 2, p. 948-967, 1969; *see* Abs. North American Geology, April 1970.

06981 **Fox, Paul J.; Schreiber, Edward.** Granodiorites from the Cayman Trench [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 553, 1970.

Fox, William T. *See* Davis, Richard A., Jr. 06949

06497 **Franklin, J. M.; Kustra, C. R.** Proterozoic rocks in the Thunder Bay area — Guide to the Proterozoic rocks of the northwestern Lake Superior area, Ontario, *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 49-68, illus., 1970.

Virtually unmetamorphosed and only slightly deformed by block faulting and tilt, these rocks of northwestern Ontario, part of the Animikie and Keweenawan units, are one of the most complete geologic records of middle and late Proterozoic sedimentation and igneous activity in eastern North America. Their mineral deposits include silver in Keweenawan dikes and Rove Formation, iron in Gunflint Formation, nickel in mafic intrusives, copper in various volcanic and sedimentary strata, and lead-zinc-barite associated with the Sibley Group. Proterozoic rocks, unconformable on the Archaean surface, are stratigraphically divided into groups of Aphebian, Paleohelikian and Neohelikian ages. The Gunflint and Rove Formations, Sibley Group of redbeds, and volcanic Osler Group and intrusives are summarized. Features at 16 stops in the Thunder Bay area are briefly described in a road log. — GDC

06904 **Fraunfelter, George H.** Dibunophyllid corals from the Houx limestone (Pennsylvanian) in north central Missouri: Illinois Acad. Sci. Trans., v. 63, no. 3, p. 319-323, illus., 1970.

Dibunophyllum randolphensis, a new species, is described from the Houx Member, a limestone, of the Little Osage Formation, Desmoinesian, of north central Missouri. The occurrence and distribution of this species in north central Missouri are recorded. — Author's abstract

Freeman, Dale. *See* Walling, James M. 06722

06982 **Freeze, R. Allan.** Hydrogeological applications of a three-dimensional, transient, saturated-unsaturated subsurface flow model [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 553-554, 1970.

06613 **French, William Stanley.** Earthquake waves following the P_n phase and their indications of focal depth and crustal structures in the Pacific Northwest States [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 767B, 1970.

Frey, F. A. *See* Reid, J. B., Jr. 00120

06983 **Frey, Robert W.; Mayou, Taylor V.** Decapod burrows in Holocene barrier island beaches, Georgia [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 554, 1970.

06637 **Friedlaender, C. G. I.** Entaxy of tridymite in the gangue of a Pb-Cu-Zn occurrence [with French abs.]: Canadian Mineralogist, v. 10, pt. 4, p. 704-709, illus., 1970.

Tridymite identified in the gangue of Dunbrack Prospect, Musquodoboit River, Halifax County, Nova Scotia, shows in addition to twinning in six-sided sectorial pattern an "ornamentation" in alternating sectors. This "ornamentation" consists of a distinct crystalline phase, with an axial angle $2V_z$ about 30° as against $2V_z$ about 17° of the main part of the composite crystal. The intergrowth of the two crystalline phases is regular and oriented. The term entaxy is suggested for such intergrowths. — Author's abstract

06922 **Friedman, Irving.** Some investigations of the deposition of travertine from Hot Springs — [Pt.] 1, The isotopic chemistry of a travertine-depositing spring: Geochim. et Cosmochim. Acta, v. 34, no. 12, p. 1303-1315, illus., tables, 1970.

Isotopic compositions of travertine and hot springs solutions were studied at two sites in Mammoth Hot Springs area of Yellowstone National Park. Travertine deposited at the orifice from water at 74° C, pH = 6.65, δC-13 = -2.3 per mil has δC-13 = +2 per mil. Travertine depositing away from the orifice is enriched in C-13, reaching values of +4.8 per mil from solutions with δC-13 = +4.43 per mil, at 27°C, and pH = 8.2 has a δC-13 of about +4.43 per mil. The decreasing difference between solid and solution is due to kinetic factors. In most samples, carbonate oxygen is in equilibrium with water O-18 at the temperature of deposition. At the orifice the water is very high in free CO_2, which is quickly lost in transit. Springs are supersaturated with respect to aragonite and calcite during most of their travel in open air. Probable source of calcium carbonate is marine carbonates adjacent to the springs. — DBV

06984 **Friedman, Melvin; Stearns, David W.** Relations between stresses derived from calcite twin lamellae and macrofractures, Teton anticline, Montana [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 555-556, 1970.

06593 **Friz, Thomas Otto.** Man and the minerals of construction — How they interrelate in the seven counties of southwestern Wisconsin [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 719B, 1970.

06634 **Froese, E.** Calculated phase relations in the system $CaCO_3$-$SrCO_3$: Canadian Mineralogist, v. 10, pt. 4, p. 665-676, illus., table, 1970.

The two compounds $CaCO_3$ and $SrCO_3$ both exhibit an orthorhombic ⇆ rhombohedral transition, and, in the system $CaCO_3SrCO_3$, orthorhombic and rhombohedral solid solutions may coexist over a considerable range of pressure and temperature. From existing experimental data, it is possible to derive ΔV and ΔS of the transitions in pure $CaCO_3$ and $SrCO_3$, if it is assumed that these values remain constant and that the solid solutions are ideal. On the basis of the same assumptions, the derived values of ΔV and ΔS may be used to calculate the composition of coexisting solid solutions at any combination of pressure and temperature. In this way, experimentally determined phase relations may be extrapolated to conditions at which no experimental data are available. — Author's abstract

Fromm, J. E. *See* Street, R. L. 06655

06517 **Frondel, Clifford.** Scandium-rich minerals from rhyolite in the Thomas Range, Utah: Am. Mineralogist, v. 55, nos. 5-6, p. 1058-1060, table, 1970.

Scandium is present in the range 0.1 to 0.7 weight percent Sc_2O_3 in late-stage minerals, including pseudobrookite, bixbyite, spessartite, hematite and beryl, in the lithophysae of the rhyolite flows of the Thomas Mountains, Utah. The Sc^{3+} ion substitutes for Fe^{3+} and Al in these minerals. Scandium also is enriched in bixbyite from volcanic rocks in Argentina, but is present only in a few ppm in bixbyite from metamorphosed sedimentary manganese deposits. — Author's abstract

06985 **Frye, John C.; Willman, H. B.** Climatic history interpreted from Lake Michigan lobe deposits and soils [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 556, 1970.

06842 **Fryer, R.; Titulaer, C.** Counts of small craters in the southern lunar highlands: Earth and Planetary Sci. Letters, v. 9, no. 1, p. 6-9, illus., tables, 1970.

Counts have been made of small (km sized) crater number densities in limited areas of the southern lunar highlands in order to investigate the nature of the anomaly found by Titulaer (1969) for large craters in this area. The anomaly is found to be detectable in this size range also, supporting the hypothesis of a cometary impact origin. An endogenic origin cannot be ruled out, however. — Authors' abstract

06986 **Fullagar, Paul D.** Age and origin of plutonic intrusions in the Piedmont of the southeastern Appalachians [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 556-557, 1970.

Fuller, M. *See* Ito, H. 06547

00173 **Furnish, W. M.; Saunders, W. Bruce; Burdick, D. W.; Strimple, H. L.** Faunal studies of the type Chesteran, Upper Mississippian of southwestern Illinois — Pt. 1, Ammonoids from the middle Chester Beech Creek Limestone, St. Clair County: Kansas Univ. Paleont. Contr.-Paper 51, 47 p., illus., tables, 1971.

The index goniatite *Lyrogoniatites* has been discovered in the Golconda Group, Hombergian Stage, middle Chester Series, of the type area. This ammonoid, *L. hartmani* Furnish and Saunders, n.sp., is comparable to species known elsewhere in America; it indicates a correlation with the Oklahoma Caney Formation (Delaware Creek Member) and equivalents in Georgia, Alabama, Arkansas, Texas, Utah, Nevada, and Alaska. An equivalent faunal zone occurs in the upper Visean Series of Europe, below the usual boundary between Upper and Lower Carboniferous. Strata just below the Chester Series in southwestern Illinois contain the *Prolecanites monroensis-Goniatites greencastlensis* fauna of late middle Visean age, the only known true Meramecan ammonoids in America. — Authors' abstract

Furumoto, A. S. *See* Adams, W. M. 06643

06644 **Furumoto, A. S.** Ionospheric recordings of Rayleigh waves for estimating source mechanisms, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 119-133, illus., table, 1970.

Rayleigh waves from large earthquakes cause delayed oscillations in the ionosphere which can be detected and recorded by high-frequency Doppler sounding technique. The 5 MHz Doppler recording reflected the oscillations at 200 km height and gave 100 percent coherence with Rayleigh waves of 20-30 second periods; the 10 MHz recording reflected the oscillations at 300 km height and showed them to be Rayleigh waves of 90-170 second periods. The 10 MHz recording of Rayleigh waves was used to estimate the initial phase of the source of the Kuril earthquake of 11 August 1969 by Brune's simplified method. The initial motion seemed to be downward. Because of its rapidity, this approach to source mechanism estimation may prove useful for the Pacific Tsunami Warning System. — Author's abstract

06693 **Fyles, James T.** The Jordan River area near Revelstoke, British Columbia — A preliminary study of lead-zinc deposits in the Shuswap Metamorphic Complex: British Columbia Dept. Mines and Petroleum Resources Bull. 57, 64 p., illus., tables, geol. maps, 1970.

Conformable lead-zinc deposits in the Shuswap Metamorphic Complex are potentially great. Although not in the same lithologic succession and probably not in the same time-stratigraphic unit, all are similar in mineralogy, sulfide textures, and mineral associations; all are deformed and metamorphosed, locally replaced by pegmatite. In the Jordan River area, metasedimentary rocks in amphibole facies of regional metamorphism are intruded by granitic gneiss and undeformed lamprophyre dikes. Style and plunge of folds vary with position on the curving northeastern flank of Frenchman Cap dome. Sulfide layers on the King Fissure property, an estimated 3 million tons, average 10 percent lead and zinc and 1 ounce per ton silver. To the west, molybdenum deposits are mined. In the Ruddock Creek area, 60 miles north of Revelstoke, calc-silicate and sulfide layers doubled by folding have reserves similar to the King Fissure property. — GDC

Gaal, Robert A. *See* Inouye, George T. 06859

06987 **Gaffey, Michael J.; Carman, John H.** A new graphical representation for the chemical evolution of the igneous rocks [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 557, 1970.

Gait, R. I. *See* Mandarino, J. A. 06639

06640 **Gait, R. I.; Mandarino, J. A.** Polytypes of tungstenite: Canadian Mineralogist, v. 10, pt. 4, p. 729-731, table, 1970.

To date only two tungstenite localities are known. Pertinent X-ray powder diffraction data are compiled on molybdenite-2H, molybdenite-3R, tungstenite, and tungstenite-3R (calculated). The Italian tungstenite described by Graeser (1963) is clearly the 2H-polytype; the Utah tungstenite is probably a mixture of the 2H- and 3R-polytypes. As it is virtually impossible to distinguish the X-ray powder pattern of a given polytype of molybdenite from the same polytype of molybdenite, tungstenite may be more widespread than the literature indicates; some "molybdenite" may in fact be tungstenite. — DBV

06766 **Galbraith, Frederic W.; Brennan, Daniel J.** Minerals of Arizona (4th edition): Arizona Bur. Mines Bull. 181, 116 p., 1970; originally published 1949.

This is the fourth edition of this publication which originally appeared in July 1941 as Bulletin 149, then in April 1947 as Bulletin 153, and was revised in 1959. It is a comprehensive compilation of known mineral localities in Arizona. — EH

Gamble, James C. *See* Wanless, H. R. 06708

Ganapathy, R. *See* Laul, J. C. 06854

06625 **Gangi, A. F.** Dynamic analysis of a small laser strainmeter, *in* Laser applications in the geosciences (J. Gauger and F. F. Hall, Jr., editors) — Symposium, Huntington Beach, Calif., 1969, Proc.: North Hollywood, Calif., Western Periodicals Co., p. 185-202, illus., 1970.

A small, 1 meter square, servo-controlled laser strainmeter has been designed based on an optical interferometer. The instrument has been designed for a strain threshold sensitivity of 10^{-10}. One arm of the optical interferometer is servo-controlled to track variations induced in the other arm of the interferometer by earth strains. The tracking of the two arms of the interferometer maintains a constant interference pattern at the interferometer output. Two types of servo-loops have been used: a DC servo-loop and an AC servo-loop. The DC servo-loop has the advantage of being simpler to analyze. The AC servo-loop, while more difficult to analyze, has the advantage of being less sensitive to DC drifts. The two servo-loops have been analyzed for their dynamic response with three different filters in the loops: (1) a single-stage low-pass filter; (2) a two-stage low-pass filter; and (3) a low-pass filter with an integrator. — Author's abstract

06837 **Gans, Carl.** Respiration in early tetrapods — The frog is a red herring: Evolution, v. 24, no. 4, p. 723-734, illus., 1970.

Mechanisms of gas exchange in breathing of modern teleost and dipnoan fishes, frogs, turtles, and crocodilians are reviewed; options available to earliest forms of the fish-tetrapod transition are analyzed, and probability and sequence of the actual changes are suggested. Cutaneous respiration and the pulse-pumping mechanism observed in modern frogs (breathing mechanics of salamanders have been little studied) cannot be extrapolated to the earliest amphibians, such as *Ichthyostega*, that were of large size and had thick, partly armored epidermis and solid, well-articulated ribs. Such animals clearly aspirated, although the muscular mechanisms are not yet certain; all modern reptiles are aspiration breathers, but at least four muscular arrangements are found, all nonhomologous with each other and with the mammalian diaphragm. Pulse pumping was retained and improved by salientians probably in association with their calls. — VMJ

Garber, M. S. *See* Sloan, C. E. 00169

06907 **Gardner, James.** A note on the supply of material to debris slopes: Canadian Geographer, v. 14, no. 4, p. 369-372, illus., 1970.

This paper deals with the supply of material to debris slope surfaces in the Moraine Lake area of the Canadian Rocky Mountains, ranging from classical talus cones to larger avalanche fans. Measurements of material supplied to the slopes showed a general decrease with increasing distance downslope per unit area, with some excep-

tions. In a hypothetical model the supply of debris decreased exponentially per unit area with expoential increase in slope surface area with distribution downslope. Empirical data, in most cases, shows a greater downslope supply per unit area than the model. In future studies lateral dimension should be considered as well as downslope dimension. — EH

Garner, L. Edwin. *See* Brown, L. F., Jr. 07039

Gast, Paul W. *See* Hubbard, Norman J. 06849

06622 **Gauger, J.; Hall, F. F., Jr.** (editors). Laser applications in the geosciences — Symposium, Huntington Beach, Calif., 1969, Proc.: North Hollywood, Calif., Western Periodicals Co., 283 p., illus., tables, 1970.

The 18 papers in this collection are divided into six sections. The first three sections treat investigations on structure, composition, and the effects of atmosphere on laser propagation. The next two concern geodetic and earth-strain measurements with laser, and the final section concerns proposals for future uses of laser in geosciences. Papers have been edited since presentation at the symposium and in some cases extended to include new developments. Eight papers are cited separately. — VSN

Gauger, J. *See* Slade, D. V. 06624

06845 **Gay, P.; Bown, M. G.; Rickson, K. O.** Mineralogical studies of lunar rock 12013,10: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 124-126, 1970.

A preliminary report is given on the mineralogy of three fragments of lunar rock 12013,10. In both light and dark areas crystals of plagioclase, alkali feldspar, ilmenite, quartz, and other minerals are encrusted with a sugary coating of quartz. The coating also contains dispersed opaque fine particles and small crystallites of SiC, brasses, and ZnO. Two larger crystals of whitlockite have been identified along with the commoner minerals. Plagioclase has compositions in the bytownite region, and probably deviates from the low structural state. Clinopyroxenes show submicroscopic exsolution, as do orthopyroxenes. — Authors' abstract

06659 **Gealy, E. L.; Gerard, R. D.** *In situ* petrophysical measurements in the Caribbean, Chap. 11 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 267-293, illus., tables, 1970.

This report describes and evaluates the effort made to obtain good logs on the last half of Leg 4. Properties commonly measured by logging include: natural radioactivity, saturated bulk density, fluid content, and electrical and acoustical characteristics. Properties of the following sediment types, and their distinguishing characteristics, are described: pelagic, redeposited, volcanic ash, igneous rocks, and terrigenous. Successful use was made of gamma-ray, neutron, and electrical survey tools. Correlation of physical properties measured on cores and *in situ* is tabulated and shown in graphs. Values of neutron porosity were calculated from the neutron curve; the top of the upper Eocene radiolarian ooze section was identified. An attempt to correlate natural gamma radiation of the cores with *in situ* measurements was made. — ESL

Gerard, R. D. *See* Gealy, E. L. 06659

Gerard, R. D. *See* Benson, W. E. 06674

Gerard, Robert D. *See* Bader, Richard G. 06657

06868 **Gergel, Thomas Joseph.** The regionalization of tidal marshes along the eastern coast of the United States [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 244B, 1970.

06679 **Geyer, Alan R.** Geology, mineral resources and environmental geology of the Palmyra quadrangle, Lebanon and Dauphin Counties: Pennsylvania Geol. Survey Atlas A 157d, 46 p., illus., tables, geol. map, 1970.

The Palmyra quadrangle area, southeastern Pennsylvania, covers parts of Dauphin and Lebanon Counties and contains the Triassic Lowland in the south and the Great Valley to the north. The southern part of the Great Valley, or Lebanon Valley, is underlain by limestone and dolomite and is typified by sinkholes, caves, and valley sinks. The northern part is underlain by shale, sandstone and limestone. Rocks exposed in the area are Middle Cambrian to late Triassic in age. Quaternary alluvium deposits are minor. Part of a major overfold occurs in the area but has no regional plunge. Outcrop belts are fairly regular, but patterns are complicated by minor folds and faults. The Annville Limestone, with a calcium carbonate content of more than 96 percent, has a maximum thickness of 250 feet; large reserves are available. Other limestone, dolomites, and shales are available for construction materials. High-magnesium stone and high-alumina shales are present. — *from* Author's abstract

06786 **Ghent, E. D.; Jones, J. W.; Nicholls, J.** A note on the significance of the assemblage calcite-quartz-plagioclase-paragonite-graphite: Contr. Mineralogy and Petrology, v. 28, no. 2, p. 112-116, illus., table, 1970.

The biotite zone assemblage: calcite-quartz-plagioclase (An_{25})-phengite-paragonite-chlorite-graphite, is developed at the contact between a carbonate and a pelite from British Columbia. Thermochemical data for the equilibrium paragonite + calcite + 2 quartz = albite + anorthite + CO_2 + H_2O yields: log fugacity H_2O + log fugacity CO_2 = 5.76 + 117 × 10^{-3} (P-1) for a temperature of 700° K and a plagioclase composition of An_{25}. By combining this equation with equations describing equilibria between graphite and gas species in the system C-H-), for the following partial pressures, H_2O = 25i2b, CO_2 = 3162b, H_2 = 2.5b, CH_4 = 52.5b, CO = 11.0b, are obtained for fugacity O_2 = 10^{-26}. If total pressure equals fluid pressure, then the total pressure during metamorphism was approximately 6 kb. The total fluid pressure calculated is extremely sensitive to the value of fugacity O_2 chosen. — Authors' abstract

00195 **Ghose, Subrata; Tsang, Tung.** Ordering of V^{2+}, Mn^{2+}, and Fe^{3+} ions in zoisite, $Ca_2Al_3Si_3O_{12}(OH)$: Science, v. 171, no. 3969, p. 374-376, illus., table, 1971.

The presence of very small amounts of Mn^{2+}, V^{2+}, and Fe^{3+} ions in zoisite can be easily detected by the electron paramagnetic resonance technique at room temperature. The Mn^{2+} and Fe^{3+} ions are completely ordered and are probably located in the Ca(1)- and Al(II)-sites, respectively, whereas the V^{2+} ions probably occur both Ca(1)- and Ca(2)-sites, with a preference for the Ca(1)-site. — Authors' abstract

Ghose, Subrata. *See* Mueller, Robert F. 06794

06988 **Ghose, Subrata; Weidner, Jerry R.; Carman, John H.** Mg^{2+}-Fe^{2+} order-disorder in a magnesium rich cummingtonite [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 557-558, 1970.

06855 **Gibb, F. G. F.; Stumpfl, E. F.; Zussman, J.** Opaque minerals in an Apollo 12 rock: Earth and Planetary Sci. Letters, v. 9, no. 3, p. 217-224, illus., tables, 1970.

Spinels in rock 12052 occur mainly as grains with cores of aluminum chromite and rims of chromian ulvospinel. Both cores (grey) and rims (pink) show zoning following the substitution $(Fe,Mg)^{+2}+Ti^{-4}$ for $2(Cr,Al)^{+3}$ and also show an increase in Fe: Mg ratio towards the outer margin. The variations in composition, taken together with those reported for Apollo 11 and other Apollo 12 samples, suggest a continuous range of solid solution between chromite and ulvospinel. The Al chromite crystallized early and the Cr depletion led to the formation of the ulvospinel rims. Ilmenites, plagioclase, and groundmass pyroxenes crystallized later followed by troilite and native iron. — *from* Authors' abstract

Gieskes, J. M. T. M. *See* Edmond, John M. 06917

06989 **Gieskes, Joris M.; Edmond, John M.** Thermodynamical approaches to geochemical problems in sea water [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 558, 1970.

06756 **Giguere, J. F.** St. Ignace Island and vicinity (east and west parts), Lake Superior, District of Thunder Bay: Ontario Dept. Mines and Northern Affairs Prelim. Geol. Maps P. 615-616, scale 1 in. to 1/2 mi., text, 1970.

Consolidated rocks in the St. Ignace Island area range in age from Early (mainland occurrences of granite and quartz diorite) to Late Precambrian (Animikie Group and Keweenawan Supergroup). Intrusive rocks occur as dikes and sills. All main sedimentary and volcanic rocks strike N. 80° E. at the west end of St. Ignace Island, rotating to an azimuth of N. 70° W. on Copper Island; faults have strikes of NW to SE. Only trace amounts of minerals have been found. — MCM

06537 **Gilbert, G. K.** Land sculpture in the Henry Mountains, [Chap.] 4 *in* Rivers and river terraces (G. H. Dury, editor): London, Macmillan and Co. Ltd., p. 95-116, illus., condensed 1970, originally published 1887.

The Colorado basin is well-suited to the study of the origin of topographic forms. The following account, based on research in the Henry Mts., restates certain principles of erosion derived from, or confirmed by work in the Colorado Plateau, and is limited to work of rain and running water. Three natural processes make up erosion: weathering, transportation, and corrasion. Chief conditions controlling erosion are declivity, character of rock, and climate. Land sculpture is controlled by declivity, structure, divides, and climate. Interdependence of these controls is pointed out, and working of the Law of Divides is applied to badland topography. Systems of drainage, in relation to structure, are consequent by emergence or sudden displacement; antecedent; and superimposed by sedimentation, alluviation or planation. The full paper was published in U.S. geographical and geological survey of the Rocky Mountain region (now the Geological Survey). — ESL

06990 **Gilbert, Ray C.; Hoagland, Alan D.** Paleokarst phenomena and the post-Knox unconformity of middle Tennessee [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 558, 1970; Econ. Geology, v. 65, no. 6, p. 737, 1970.

06779 **Giroud, Jean Pierre; Gupta, Sachinder N.** Guide for depth of foundation exploration — Discussion [of paper 7120 by Ronald E. Smith, 1970]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 2140-2144, illus., 1970.

Paper 7120 was published ibid., v. 96, no. SM 2, p. 377-384, 1970; *see* Abs. North American Geology, January 1971.

06781 **Giroud, Jean Pierre.** Settlement problem oriented computer language — Discussion [of paper 7178 by Robert L. Schiffman, Robert V. Whitman, and Jane C. Jordan, 1970]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 2160-2162, illus., table, 1970.

Paper 7178 was published ibid., v. 96, no. SM 2, p. 649-669, 1970; *see* Abs. North American Geology, January 1971.

Goclowski, John C. *See* Butera, Anthony W. 06704

06991 **Goddard, John G.** The $^{230}Th/U^{234}$ dating of saline deposits from Searles Lake, California [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 558, 1970.

00122 **Goetze, Christopher.** High temperature rheology of Westerly granite: Jour. Geophys. Research, v. 76, no. 5, p. 1223-1230, illus., table, 1971.

The creep of Westerly granite was measured up to the melting point (720°C) under 4-5 kb external pressure and 1 kb water pressure for differential stresses from 128 to 643 bars. These measurements involve considerably smaller differential stresses and

anelastic strains than any previously reported. The results suggest that effective viscosities computer from glacial uplift data may be smaller than those corresponding to large strains by as much as two orders of magnitude. Poor agreement is found with previous high-temperature creep results on rock specimens at room pressure. — DBV

06572 **Gold, L. W.** Process of failure in ice [with French abs.]: Canadian Geotech. Jour., v. 7, no. 4, p. 405-413, illus., 1970.

Information is presented on the failure behavior of columnar-grained ice during compressive creep and constant strain rate tests. The role of crack formation in establishing the failure condition is briefly described. Breakdown of structure is responsible for a marked change in the creep behavior of ice in the stress range of 10 to 12 kg per cm^2. A ductile-to-brittle transition is observed at a strain rate of about 5×10^{-3} min^{-1}. The upper yield stress in constant strain rate tests is shown to increase with increase in rate of strain up to the ductile-to-brittle transition. — Author's abstract

06898 **Golden, Julia; Nitecki, Matthew H.** Catalogue of type and referred specimens of fossil Echinozoa (Echinoidea and Cyclocystoidea) in Field Museum of Natural History: Fieldiana — Geology, v. 20, no. 2, p. 43-51, 1970.

Holotypes and referred specimens of the echinoderm classes Echinoidea and Cyclocystoidea from the Field Museum and former Walker Museum (Univ. Chicago) collections are listed alphabetically; casts of additional types are listed separately. Generic and specific names are listed in their original spelling, followed by name of author of the species and original publication date. Subsequent taxonomic and nomenclatural changes are noted. Complete bibliographic references are given for each specimen or lot. The echinoids, 17 species in 11 genera (plus casts of 3 species), range from Devonian to Upper Cretaceous in age; most are from the Lower Mississippian of central and east-central U.S., several are from the Upper Cretaceous of Mississippi. The cyclocystoids, three species of one genus, are from the Upper Ordovician of the Cincinnati arch region and southern Illinois. — VMJ

06899 **Golden, Julia; Nitecki, Matthew H.** Catalogue of type and referred specimens of Echinozoa (Edrioasteroidea) in Field Museum of Natural History: Fieldiana — Geology, v. 20, no. 3, p. 53-64, 1970.

Holotypes and referred specimens of the echinoderm class Edrioasteroidea from the Field Museum and former Walker Museum collections are listed alphabetically; casts of additional types are listed separately. The generic and specific names are listed as originally spelled, followed by name of author of the species and original publication date. Subsequent taxonomic and nomenclatural changes are noted and cross-referenced. Complete bibliographic references are given for each specimen or lot. The specimens represent 10 species in four genera; the casts represent 24 species in three of the same and five additional genera. The species range from Cambrian through Upper Mississippian in age; most are from the Middle and Upper Ordovician of central Kentucky and the Cincinnati arch region, fewer are from the Lower Mississippian of central and east-central U.S. — VMJ

06900 **Golden, Julia; Nitecki, Matthew H.** Catalogue of type and referred specimens of fossil Stelleroidea in Field Museum of Natural History: Fieldiana — Geology, v. 20, no. 4, p. 65-75, 1970.

Holotypes and referred specimens of the echinoderm class Stelleroidea (subphylum Asterozoa) from the Field Museum and former Walker Museum collections are listed alphabetically; casts of additional types are listed separately. Generic and specific names are listed as originally spelled, followed by name of author of the species and original publication date. Taxonomic and nomenclatural changes to date are noted and cross-referenced. Complete bibliographic references are given for each specimen or lot. The specimens represent 19 species in 11 genera (plus casts of 3 species); most are from the Upper Ordovician of the Cincinnati arch region and the Lower Mississippian of central and east-central U.S., also a few from the Lower and Middle Ordovician, Silurian, Devonian, Upper Mississippian, and Upper Cretaceous. — VMJ

Goldich, S. S. *See* Hanson, G. N. 06479

Goldich, S. S. *See* Peterman, Z. E. 06489

Goldthwait, Richard P. *See* Dreimanis, Aleksis. 06960

00124 **Gordon, Robert B.** Observation of crystal plasticity under high pressure with application to the Earth's mantle: Jour. Geophys. Research, v. 76, no. 5, p. 1248-1254, illus., 1971.

Direct experimental measurement shows the activation volume for the motion of glide dislocations in crystals always to be less than the activation volume for thermally activated atom movements. The activation volumes for thermally activated atom movements remains, however, the rate limiting step in plastic flow at all depths in a mantle composed of solid close-packed oxides. The occurrence of partial melting and of pressure-induced phase transformations is expected to result in zones of low shear strength in the mantle. Plastic flow may largely be localized to these zones. — Author's abstract

06706 **Gould, H. R.** The Mississippi delta complex, *in* Deltaic sedimentation, modern and ancient: Soc. Econ. Paleontologists and Mineralogists Spec. Pub. 15, p. 3-30, illus., table, 1970.

The Mississippi deltaic plain extends from an apex at the mouth of the Mississippi alluvial valley to a base of 200 mi along the Louisiana coast. Under this plain and adjacent continental shelf and slope is a huge mass of late Quaternary river-mouth deposits which occupy a seaward deepening trough-like depression that developed contemporaneously with deposition and is localized in the depositional area. Maximum sediment thickness is 1,000 feet under the continental shelf at the seaward limit. Beneath the deltaic plain and inner shelf, late Quaternary deposits form a thick onlapping sequence, overlain by a thinner offlapping series. The onlap records eustatic rise of sea level from its last low stand, and the offlap progradation after the sea reached its present level 3500 to 4000 yr ago. Both shallow-water deltas and the active deepwater birdfoot delta are characterized by distinctive facies. — VSN

06992 **Gould, Stephen J.** *Gryphaea* did not alter its coiling during the Lower Lias (Mirabile dictu) [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 559, 1970.

06614 **Graham, Earl Kendall, Jr.** The elastic coefficients of forsterite as a function of pressure and temperature [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 767B, table, 1970.

07076 **Grantz, Arthur; Wolf, S. C.; Breslau, Lloyd; Johnson, T. C.; Hanna, W. F.** Reconnaissance geology of the Chukchi Sea as determined by acoustic and magnetic profiling, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. F1-F28, illus., 1970.

A cooperative program of the U.S. Geological Survey and the U.S. Coast Guard in the Chukchi Sea in 1969 resulted in 2500 km of low-frequency sparker profiles, 2300 km of magnetometer profiles, and 370 km of high-resolution sparker profiles, as well as 36 sonobuoy runs. Analysis of the data indicates that of 350,000 sq km of the Chukchi Sea east of the international dateline and south of the continental shelf break separating it from the Arctic Ocean, some 230,000 sq km in the northern part is probably underlain by Late Cretaceous and older sedimentary rocks and 75,000 sq km in the southern part is underlain by probable Tertiary rocks; both areas possibly may have gas, coal, and oil reserves. Geologic interpretations of the acoustic profiles are shown on maps and in cross sections. — VSN

06993 **Gray, Jane; Boucot, A. J.** Silurian trilete spore occurrences [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 560-561, 1970.

06759 **Green, H. W., 2d; Griggs, D. T.; Christie, J. M.** Syntectonic and annealing recrystallization of fine-grained quartz aggregates [with German abs.], *in* Experimen-

tal and natural rock deformation — Internat. Symposium, Darmstadt, Germany, 1969, Proc. (P. Paulitsch, editor): Berlin and Heidelberg, Germany, Springer-Verlag, p. 272-335, illus., tables, 1970.

Results are given of an experimental study of preferred orientation in quartz aggregates under varying temperatures and strain-rates. Development of several preferred orientations for both α-quartz and β-quartz fields, each of which correlates with specific experimental conditions and textural characteristics, indicates that more than one orienting mechanism is involved. Possible mechanisms are discussed (stored strain energy, elastic anisotropy, oriented nucleation, oriented growth hypotheses). A comparison with natural preferred orientations indicates that the mechanism for development of r-maximum fabric (α-quartz field at high temperature or slow strain-rates) and crossed girdles of c-axes operates under some conditions in nature, such as in development of crossed-girdle pattern common in metamorphic rocks. The maximum of c-axes normal to foliation in some granulites may be due to deformation in the β-quartz field. — VSN

Green, J. *See* Metherell, A. F. 06629

06478 **Green, John C.** Ultramafic bodies in the Vermilion district near Ely, Minnesota [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 17, 1970.

06995 **Greiner, Gary O. G.** On the construction of calcite walls in foraminifera [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 561-562, 1970.

06996 **Griffin, John R.** Prelithification slump structures in Middle Silurian rocks of central Maine [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 562, 1970.

06715 **Griffin, Villard S., Jr.** A probable pre-Triassic mafic intrusive in the Anderson 15-minute quadrangle, South Carolina: South Carolina Div. Geology Geol. Notes, v. 14, no. 4, p. 97-104, illus., 1970.

A large north-northeast trending amphibolite body at least 14 mi (22.5 km) in length and having a maximum width of 3 mi (5 km) was discovered during a geologic reconnaissance of the Inner Piedmont belt north of Anderson, South Carolina. An igneous texture is significant in a portion of this mafic body, and petrographic analysis indicates that much of this body has a gabbroic composition. The presence of cross cutting pegmatite bodies, some of which alter the rock to biotite gneiss in their immediate vicinity, indicate that this mafic body is pre-Triassic in age. — Author's abstract

07042 **Griffin, Villard S., Jr.** Position of the Kings Mountain belt in Abbeville County, South Carolina: Southeastern Geology, v. 12, no. 2, p. 105-113, illus., 1970.

The sericite schist zone of Kings Mtn. belt, interpreted by Overstreet and Bell (1965), has been verified by reconnaissance mapping; no valid basis was found for differentiation of their southeastern Kings Mtn. belt hornblende schist zone from Charlotte belt rocks. Kings Mtn. belt in Abbeville County, and northeast, is represented only by the sericitic schist zone. Mylonites, ultramylonite breccias and cataclasites occur within the sericite schist belt and define its margins. Southwestward the schist belt narrows and disappears. A cataclastic zone separates augen granite gneisses in the inner Piedmont and Charlotte belts; it is a continuation of cataclasites associated with the schist belt, and can be traced into Georgia. The Wacoochee belt of Hewett and Crickmay (1937) is probably a continuation of Kings Mtn. belt into Georgia and Alabama, and if valid, would form a major tectonic feature. — *from* Author's abstract

Griggs, D. T. *See* Green, H. W., 2d. 06759

Grigor'eva, L. F. *See* Fedoseev, A. D. 06508

06524 **Groat, Charles G.** Geology and hydrology of Troy Playa, San Bernardino County, California, Chap. 5 *in* Geology and hydrology of selected playas in western United States (Ward S. Motts, editor) — Univ. Massachusetts, Geology Dept., Contract AF19(628)-2486, Final Sci. Rept., Pt. 2: Bedford, Mass., U.S. Air Force Office Aerospace Research, p. 166-213, illus., 1970.

Troy Playa in the lower Mojave Desert lies in an area once occupied by a late Pleistocene lake. The upper 10-15 feet of playa sediments consist of an upper mud facies deposited in ephemeral lakes, underlain by a sand facies which probably records fluvial and eolian deposition. Most of the playa has a puffy surface produced by capillary discharge of shallow ground water. A hard surface is present where the water table is within the sand facies. Declining ground-water levels could foster a conversion from a soft puffy to a hard-compacted playa surface, aided by compaction by flooding and the ensuing dessication. The dynamic character of the playa surface is also shown by changes in the morphology of the playa surface. Heavy pumpage west of the playa and minimal recharge have caused decline in the potentiometric surface throughout the valley, and poor quality water from the playa is intruding into fresh-water aquifers west of the playa. — DBV

06997 **Groat, Charles G.** Excavation of Presidio Bolson, trans-Pecos, Texas [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 562-563, 1970.

06998 **Groshong, Richard H., Jr.** Twinned calcite as a natural strain gage [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 563, 1970.

06999 **Gross, David L.; Lineback, Jerry A.** Age and stratigraphy of Pleistocene sediments in southern Lake Michigan [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 563-564, 1970.

06597 **Gross, David Lee.** Glacial geology of Kane County, Illinois [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 757B, 1970.

06795 **Grover, John E.; Orville, Philip M.** Partitioning of cations between coexisting single- and multi-site phases — A reply with incidental corrections [to discussion of 1969 paper by R. F. Mueller, G. Subrata, and S. K. Saxena, 1970]: Geochim. et Cosmochim. Acta, v. 34, no. 12, p. 1361-1364, table, 1970.

This is a reply to a discussion by Mueller, Ghose, and Saxena (ibid., p. 1356-1361) of a paper published in Geochim. et Cosmochim. Acta, v. 33, no. 2, p. 205-226, 1969; *see* Abs. North American Geology, July 1969.

07103 **Gryc, George.** History of petroleum exploration in northern Alaska, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. C1-C8, illus.; discussion, p. C9-C10, 1970.

Early geologic exploration of the North Slope of Alaska (crest of Brooks Range to Arctic Ocean) was, for the most part, by members of the U.S. Geological Survey beginning with the traverse of Peters and Schrader in 1901, continuing with the mapping of the Arctic coast east of Barrow by Leffingwell in 1906-14, further work by Smith in 1917, and with establishment in 1923 of the Naval Petroleum Reserve (NPR-4), mapping by Smith and Mertie from 1923-26. Exploration of NPR-4 was again undertaken in 1944 with the Pet-4 program, continued through 1952, and resulted in discovery of 1 large oil field, Umiat; 1 large gas field, Gubik; 1 small gas field, Barrow; and 3 prospective gas fields and 2 minor oil deposits. Major oil companies began extensive geophysical surveys and geologic studies in 1958 which led to recent major discoveries. The major geologic features are outlined, and a stratigraphic chart is included. — VSN

06870 **Gupta, Alok Krishna.** The system forsterite-diopside-akermanite-leucite and its significance in the petrogenesis of potassium-rich mafic and ultramafic volcanic rocks [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 249B-250B, 1970.

Gupta, Sachinder N. *See* Giroud, Jean Pierre. 06779

07000 **Gutschick, Raymond C.** The stratigraphy and structure of the Kentland impact anomaly, Indiana [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 564, 1970.

07048 **Guy, Harold P.** Sediment problems in urban areas: U.S. Geol. Survey Circ. 601-E, p. E1-E8, illus., table, 1970.

Sediment movement and deposition, a part of the natural environment, become important only when man is affected. Severe sediment problems occur when natural circumstances are altered, for example, when covering vegetation is removed, when flow regime in channels is altered by realinement or by change in flow, or when fill or construction obstruct the flowway. Sediment problems are usually grouped in relation to land and channel erosion, stream transport, and deposition processes. Sediment-measurement programs help in recognizing these problems and cost analyses are essential in planning solutions to them. Steps necessary for achieving control of urban sediment are outlined. — EH

07001 **Hacquebard, Peter A.; Donaldson, J. Roger.** Coal rank studies in the Rocky Mountain foothills belt of Canada [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 564-565, 1970.

06521 **Hagar, David J.** Geology and hydrology of Coyote Playa, Chap. 3, Pt. 1 *in* Geology and hydrology of selected playas in western United States (Ward S. Motts, editor) — Univ. Massachusetts, Geology Dept., Contract AF19(628)-2486, Final Sci. Rept., Pt. 2: Bedford, Mass., U.S. Air Force Office Aerospace Research, p. 66-107, illus., tables, 1970.

This paper first describes the geomorphic, geologic, and climatic setting of Coyote Lake playa in the Mojave Desert, and reviews previous investigations. It then describes in some detail the geomorphology of the playa and adjacent areas, its sedimentology and hydrology and its geologic history. It is the relict of a Late Pleistocene lake. The extremely fine-grained playa clays have low moisture content and are very hard. It is concluded that except in marginal areas, an insignificant amount of water discharges through the playa surface; its varied surface morphology is due primarily to the interaction of infiltrated surface water with playa sediments. — DBV

Hall, F. F., Jr. *See* Gauger, J. 06622

Hall, J. L. *See* Boyne, H. S. 06627

07057 **Haller, John.** Tectonic map of East Greenland (1:500,000) — An account of tectonism, plutonism, and volcanism in East Greenland: Medd. Grönland, v. 171, no. 5, 286 p., illus., tables, 1970.

Structural history of the Caledonide orogenic belt of East Greenland is discussed: first, Precambrian basement, Thule Group sedimentation, and minor intrusions; then Carolinidian orogeny and succeeding cycles of sedimentation in the northeastern basin-and-swell region, and Central East Greenland geosyncline of very thick late Precambrian and Cambro-Ordovician beds. The Caledonian orogeny progressed in distinct periods of tectonism: the main, Silurian deep-seated mobility; later, Devonian spasms of folds and thrusts with granitic intrusions in the intramontane Old Red Sandstone molasse basin; minor folding and thrusting, through late Paleozoic sedimentation that in the south filled faulted troughs of a compound rift system. The Mesozoic included block faulting and transgressive marine seas of deposition; the Cenozoic, Tertiary sedimentary successions, vast basaltic lava flows, dikes, and vertical displacements. — GDC

Haller, W. A. *See* Filby, R. H. 06554

Halls, C. *See* Stumpfl, E. F. 06768

07002 **Halsey, S. D.; Perkins, R. D.** Microborings in relict sediments, a possible key to Carolina shelf history [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 565, 1970.

07003 **Hambleton, William W.** Toward a concept for a national geoscience information program, a report of the Committee on Geoscience Information of the American Geological Institute [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 565, 1970.

06923 **Hamblin, W. K.; Best, M. G.** (editors). The western Grand Canyon district: Utah Geol. Soc. Guidebook to Geology of Utah, no. 23, 154 p., illus., tables, 1970.

The Grand Canyon has been cut by the Colorado River through sedimentary strata into the underlying metamorphic basement complex. The region to the west displays a late Cenozoic history of volcanism and tectonism that is not widely appreciated. As described here, it encompasses some 7,000 sq mi in northwestern Arizona north of the Colorado River and part of adjacent Utah. Lying at the junction of the Basin and Range and Colorado Plateau provinces, this region affords an opportunity to document the development of these two tectonic-geomorphic segments of the continent. The road log and seven papers in this guidebook are cited separately; they summarize results of a series of studies by one or both of the editors. In pocket, a map locates major faults and centers of recent volcanic eruptions. — GDC

06924 **Hamblin, W. K.** Structure of the western Grand Canyon region, *in* The western Grand Canyon district: Utah Geol. Soc. Guidebook to Geology of Utah, no. 23, p. 3-20, illus., 1970.

Uniquely combined here are faulting in strata containing numerous marker horizons, erosion exposing both up and down movement details, and contemporaneous volcanism producing time markers for late Cenozoic displacements. Major structures are the N-S trending Grand Wash, Hurricane, and Toroweap fault systems, upthrown to east, with reverse-drag on downthrown block; their prominent scarps have northward increasing displacements of 200 to 16,000 feet. They have influenced the course of Colorado River in development of Grand Canyon, and also had a role in regional uplift which permitted canyon cutting. Grand Wash fault is best expressed in Grand Wash Cliffs, a bold step-scarp 4,000 feet high near the Grand Canyon mouth. The en echelon, 200-mi Hurricane fault, with large areas of fault surfaces exposed on the Shivwits Plateau, is crossed by eight lava flows that record stages of down-slip. The 300-mi Sevier-Toroweap-Aubrey structure is the longest on the Colorado Plateau. — GDC

06925 **Hamblin, W. K.** Late Cenozoic basalt flows of the western Grand Canyon, *in* The western Grand Canyon district: Utah Geol. Soc. Guidebook to Geology of Utah, no. 23, p. 21-37, illus., 1970.

Basaltic flows and cinder cones of this area, in small isolated fields, are trivial in volume compared with great volcanic fields of the United States, but provide important data on the tectonic and geomorphic history. Older flows cap high buttes and mesas, preserving remnants of erosional surfaces; others, displaced, document recurrent movement along major faults; younger flows, capping sinuous ridges called inverted valleys, record late extrusions prior to the present erosion cycle; the youngest partly fill present stream valleys or cascade over escarpments as "frozen" lava falls. The relative ages of four stages of lava flows in this area are based on the nature of the surface upon which they were deposited, as in the St. George Basin, and Shivwits and Uinkaret Plateaus. Present study of geomorphic evolution in the Shivwits Plateau supports the concept of pedimentation. — GDC

Hamblin, W. K. *See* Best, M. G. 06927

06928 **Hamblin, W. K.** A summary of the stratigraphy of the western Grand Canyon region, *in* The western Grand Canyon district: Utah Geol. Soc. Guidebook to Geology of Utah, no. 23, p. 81-91, illus., 1970.

Details of the stratigraphy of the Paleozoic rocks in the Grand Canyon have been published by E. D. McKee (1933, 1938, 1954, and 1969). This summary is taken from his work and is intended to provide a brief description and illustration of the rocks seen in the western Grand Canyon region on this field trip which emphasizes its structural and volcanic history. — GDC

07073 **Hamblin, W. K.; Best, M. G.** Road log, *in* The western Grand Canyon district: Utah Geol. Soc. Guidebook to Geology of Utah, no. 23, p. 93-154, illus., 1970.

In this road log are features studied at 15 stops: 1, near Gearge, the Santa Clara flow of Stage IV lava; 2, Middleton flows and basalt petrology in a Stage II inverted valley; 3, more mafic, columnar jointed Washington flow; 4, major geologic features of St. George Basin; 5, Grand Wash basalt petrology; 6, regional view of Hurrican fault, with hike to top; 7, overlook onto the Shivwits and Uinkaret Plateaus; 8, panorama of volcanic field on southern Uinkaret Plateau; 9, camp on rim of inner gorge near Vulcan's Throne, largest cone, canyon morphology and volcanic features, profile here compared with that in National Park; 10, Toroweap flow, a Uinkaret basalt type; 11, fault displacement in very high lava dam remnant; 12, Grand Staircase with obvious reverse drag; 13, Hurricane Valley view with spectacular and varied regional geology, structural details along fault; 14, core of Virgin anticline, and 15, its north flank. — GDC

07107 **Hamblin, W. K.** Lava dams in the Toroweap and Prospect areas of the Grand Canyon, *in* The western Grand Canyon district: Utah Geol. Soc. Guidebook to Geology of Utah, no. 23, p. 39-55, illus., 1970.

Lava cascades over the rim of Grand Canyon and across the Colorado River, cap remnants of much older flows in a sequence of ancient barriers that created temporary lakes upstream. Repeatedly, as these were breached and destroyed, new dams formed; remnants cling to sidewalls with juxtaposed younger flows, expressing relative age of major units. The cascades are relatively thin; the exceptionally thick inner gorge remnants must represent ponded lava. Correlative units can be distinguished by unique petrography, or by internal structure, jointing, stratigraphic sequences, or by elevation and gradients of top surfaces. Tentatively classified are: older and younger intracanyon flows, valley fill, and lava cascades; also dikes and cinder cones. Volcanic features at mouth of Toroweap Valley, the Esplanade cascades, and a complex of thick basalts in Prospect Canyon are described. Schematic diagrams show sequence of volcanic events. — GDC

07004 **Hamburger, Richard.** Geologic factors in rapid excavation with nuclear explosions [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 566, 1970.

00150 **Hamilton, Edwin L.** Elastic properties of marine sediments: Jour. Geophys. Research, v. 76, no. 2, p. 579-604, illus., tables, 1971.

This paper discusses appropriate elastic and viscoelastic models for water-saturated porous mediums. For small stresses such as a sound wave, water-saturated sediments respond elastically and the elastic equations of the Hookean model can be used to compute unmeasured elastic constants. However, to account for attenuation, the favored model is "nearly elastic" or linear viscoelastic. Using a method developed from theory, the bulk modulus is computed for this model. This value, together with measured values of density and compressional velocity, are used to compute other elastic constants which are then discussed in relation to a wide variety of laboratory and in-place measurements made on marine sediments from three major environments in the North Pacific and adjacent areas: continental terrace, abyssal plain, and abyssal hill. — DBV

07005 **Hamilton, Robert M.; Healy, John H.** Aftershocks of underground nuclear explosions [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 566, 1970.

Hammerquist, Donald W. *See* Hoskins, Earl R. 07028

07006 **Handin, John W.; Logan, John M.** Experimental folding of rocks under confining pressure [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 567, 1970.

07007 **Haner, Barbara E.** Segmented submarine fan model, a relationship between recent and ancient sedimentary fan facies [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 567, 1970.

00146 **Hanks, Thomas C.; Whitcomb, James H.** Comments on paper by John W. Minear and M. Nafi Toksöz, "Thermal regime of a downgoing slab and new global tectonics" (1970): Jour. Geophys. Research, v. 76, no. 2, p. 613-616, 1971.

For original paper, *see* ibid., v. 75, no. 8, p. 1397-1419, 1970; Abs. North American Geology, August 1970.

00153 **Hanks, Thomas C.** Model relating heat-flow values near, and vertical velocities of mass transport beneath, oceanic rises: Jour. Geophys. Research, v. 76, no. 2, p. 537-544, illus., table, 1971.

The heat transport equation along the stagnation point streamline is solved by the method of matched asymptotic expansions as a first approximation of the temperature distribution directly beneath an oceanic rise. The surface heat flow near the rise crest is primarily controlled by the thickness of, and temperature at the base of, the thermal boundary layer; at greater depth, a wide range of velocity and temperature distributions can exist without materially altering the thermal structure of the boundary layer. Within the limitations of the assumed model, observed values of Q crest are too low by at least several factors of 2, unless igneous emplacement at the axis of spreading has been at a relatively low level for the past 0.5-1 m.y. The thickness of the thermal boundary layer is probably the primary constraint on the seismic depth of spreading centers and associated transform faults. — DBV

Hanna, W. F. *See* Grantz, Arthur. 07076

07008 **Hanor, Jeffrey S.; Marshall, Neil F.** Quantitative analysis of worm burrowing and sediment mixing in some recent southern California borderland sediments [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 568, 1970.

06479 **Hanson, G. N.; Goldich, S. S.** Early Precambrian geology of the Saganaga-Northern Light Lakes area, Minnesota-Ontario [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 18, 1970.

06480 **Hanson, G. N.; Malhotra, R.** K-Ar ages of mafic dikes in northeastern Minnesota [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 19, 1970.

07009 **Harding, Samuel T.; Hardy, H. Reginald, Jr.** Acoustic emission during transient and secondary creep and during creep recovery [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 569, 1970.

Hardy, H. Reginald, Jr. *See* Harding, Samuel T. 07009

07010 **Hare, P. E.; Abelson, P. H.** Dynamics of nitrogeneous organic matter in marine sediments [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 569, 1970.

Harmon, Russell S. *See* Reid, Arch M. 06841

06871 **Harper, John David.** Stratigraphy, sedimentology, and paleoecology of the Rondout Formation (Late Silurian), eastern New York State [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 250B, 1970.

06724 **Harris, D. C.** New data on tyrrellite: Canadian Mineralogist, v. 10, pt. 4, p. 731-736, illus., tables, 1970.

Results of an electron probe analysis and of reflectivity and microhardness measurements on tyrrellite from the Beaverlodge area of Saskatchewan and from Bukov in Czechoslovakia are presented. The ratio of cations in the crystal lattice is variable,

which may account for observed differences in reflectivity, microhardness, and unit cell dimensions. In general, reflectivity and microhardness seem to increase with increasing Co content; the Co/Ni ratio may be responsible for the observed variations. — DBV

06753 **Harris, D. C.; Cabri, L. J.; Murray, E. J.** An occurrence of a sulphur-bearing berzelianite: Canadian Mineralogist, v. 10, pt. 4, p. 737-740, illus., tables, 1970.

This paper reports the first occurrence of a naturally-occurring sulfur-bearing berzelianite, from Martin Lake in northern Saskatchewan. Results of electron microprobe analysis and measurements of microhardness and unit cel dimensions are given. Experiments in the synthetic system show that at least 50 atomic number percent S can substitute for Se in berzelianite, with retention of the cubic structure but decreasing unit-cell parameter. The mineral in question contains 5.7 weight percent S. — DBV

06564 **Harriss, Robert C.; Troup, Arthur G.** Chemistry and origin of freshwater ferromanganese concretions: Limnology and Oceanography, v. 15, no. 5, p. 702-712, illus., tables, 1970.

Ferromanganese concretions from Grand Lake and Ship Harbour Lake in Nova Scotia and Mosque Lake in [southeastern] Ontario are most common in water 0.5 to 2 m deep. X-ray diffraction studies show the ferromanganese portions of the concretions to be amorphous. Petrographic and electron probe studies of the ferromanganese material reveal chemical banding of iron and manganese. Bulk chemical analyses indicate that the Fe:Mn ratios of concretions from different sites within a single lake are similar, whereas concretions from different lakes have characteristic Fe:Mn ratios. Trace element concentrations are different in different lakes and are generally several orders of magnitude less than those of oceanic nodules. — Authors' abstract

Hartshorn, Joseph H. *See* Colton, Roger B. 00160

07011 **Hasegawa, H. S.** Analysis of teleseismic signals from underground explosions originating in four geologic environments [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 570, 1970.

Hatch, Norman L., Jr. *See* Osberg, Philip H. 00189

06695 **Hatch, Norman L., Jr.; Norton, S. A.; Clark, R. G., Jr.** Geologic map of the Chester quadrangle, Hampden and Hampshire Counties, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-858, scale 1:24,000, section, text, 1970.

Stratified rocks (Cambrian-Devonian) in the Chester quadrangle comprise five formations; the four pre-Silurian contain different proportions of quartz-feldspar-mica gneiss, schist, and granulite, carbonaceous schist and quartzite, and amphibolite and feldspar rock. The Silurian-Devonian Goshen Formation, lithologically less complex, contains no recognized metavolcanic rocks and consists mostly of gray, carbonaceous metasedimentary rocks. Dominant structures in the stratified rocks are a set of large isoclinal folds and a well-developed schistosity parallel to axial planes of these folds. The apparently anomalous distribution of kyanite and staurolite in pre-Goshen and Goshen rocks is not yet completely understood. Known possible mineral resources are sand and gravel, emery, and talc; quartz veins are abundant and some have been prospected. — MCM

06856 **Hatheway, Allen W.** Basalt melts in a simulated lunar environment: Arizona Univ. Lunar and Planetary Lab. Commun., v. 8, pt. 4, no. 151, p. 289-296, illus., 1970.

Hawaiian basalt samples were melted and partially outgassed in vacuo in order to obtain a material comparable to that extruded onto the lunar surface. Surface characteristics, internal structure, and bearing strength are described. Densities averaging 0.22 g per cm^3 and bearing strengths as high as 9 kg per cm^2 were encountered. — Author's abstract

07069 **Hatheway, Allen W.; Herring, Alika K.** Bandera lava tubes of New Mexico, and lunar implications: Arizona Univ. Lunar and Planetary Lab. Commun., v. 8, pt. 4, no. 152, p. 299-327, illus., 1970.

Olivine basalts, which erupted over the past million years on the North Plains of Valencia County, New Mexico, exhibit lava-tube systems. These fluid-transport tunnels are near-circular in cross section and lead downslope from volcanic cinder cones over mean gradients of from 0°35′ to 1°12′ for distances up to 28.6 km. The tubes may either be straight or sinuous, and are sometimes modified by overflow features, spatter-cones, and several types of collapse structures and subsidence pits. They appear genetically related to sinuous rilles on the lunar surface. A large-scale map is appended. — Authors' abstract

07012 **Haugh, Bruce N.; Lane, N. Gary.** Water vascular system of Mississippian camerate crinoids [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 570-571, 1970.

Hausser, O. *See* Ollerhead, R. W. 06559

06670 **Hay, W. W.** Calcareous nannofossils from cores recovered on Leg 4, Chap. 23 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 455-501, illus., tables, 1970.

This section gives an account of the species present and their relative abundances, and a discussion of the nannoplankton biostratigraphy of the cores from Leg 4 off Brazil and in the Caribbean Sea. Almost no assemblages older than middle Miocene are found in Leg 4 cores, and no early Oligocene. Late Oligocene to Pleistocene assemblages were each encountered at two or more sites. On most sites drilled, at least part of the sampled section was devoid of calcareous nannofossils due to solution. Species identified and studied are listed systematically. Distribution by cores is tabulated. — ESL

Hay, W. W. *See* Benson, W. E. 06674

Hay, William W. *See* Bader, Richard G. 06657

Hayes, D. W. *See* Corey, J. C. 06819

07093 **Hayre, Harbhajan S.** Geophysical dielectric constant determination: IEEE Trans. Geosci. Electronics, v. GE-8, no. 4, p. 289-295, illus., tables, 1970.

A simple geophysical approach for determining dielectric constants and conductivity of natural soils from a correlation study of their respective P-wave velocities or vice versa is described. Instrumentation (including a box with free-running multivibrator, an 8-bit binary counter, and a high-quality dry-cell power supply; a geophone and cable assembly; and a two-conductor cable) is described and illustrated with block and circuit diagrams. The formula $\epsilon_c = \epsilon_r - j60\lambda\sigma$, where ϵ_c is dielectric constant, ϵ_r is relative permittivity, λ is wavelength, and σ is electrical conductivity, relates P-wave velocity to real and imaginary dielectric constant components. A formula is also given for dependence of the real part of the dielectric constant ϵ_r on density. — VSN

07013 **Hays, James D.** Extinctions and reversals of the earth's magnetic field [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 572-573, 1970.

07014 **Hayward, O. T.** Relevant geology in an urban world [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 573, 1970.

06598 **Head, James William, 3d.** An integrated modelel of carbonate depositional basin evolution — Late Cayugan (Upper Silurian) and Helderbergian (Lower Devonian) of the central Appalachians [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 758B-759B, 1970.

07015 **Heald, Emerson F.; Weiss, Clair W.** Kinetics and mechanism of the anatase/rutile transformation, as catalyzed by ferric oxide and reducing conditions [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 573-574, 1970.

Healy, John H. *See* Hamilton, Robert M. 07005

Heath, G. Ross. *See* Pak, Hasong. 06727

07016 **Hecht, Alan D.; Savin, Samuel M.** Planktonic foraminifera, environmental stress model as a paleoclimatic indicator [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 574, 1970.

Hedge, C. E. *See* Doe, B. R. 06955

07056 **Hedlund, Richard W.; Engelhardt, Donald W.** *Rugaepollis fragilis* sp.nov. from the Tertiary of Kachemak Bay, Alaska [with French abs.]: Pollen et Spores, v. 12, no. 2, p. 173-176, illus., 1970; erratum, ibid., no. 3, p. [482], 1970 [1971].

The new species of pollen described is a rare component of rich palynologic assemblages recovered from nonmarine siltstones and claystones of the upper Kenai Formation (Miocene-Pliocene, Clamgulchian Stage) from measured outcrop sections along the shore of Kachemak Bay, Kenai Peninsula. *Rugaepollis fragilis* n.sp. is distinguished from the genotype, *R. kachemakensis* Engelhardt, 1966, which occurs in the same samples, by its smaller size, granulate ornamentation, and fragile exine. The unusual pentagonal arrangement of apertures suggests possible affinities with several dicot angiosperm families. — VMJ

07017 **Heezen, Bruce C.** Modern abyssal ichnology [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 574, 1970.

07018 **Heindl, L. A.** An approach to the rational classification of hydrological maps [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 574-575, 1970.

06818 **Helgeson, Harold C.; Mackenzie, Fred T.** Silicate-sea water equilibria in the ocean system: Deep-Sea Research, v. 17, no. 5, p. 877-892, illus., tables, 1970.

Chemical potentials of major chloride components of sea water are functions solely of temperature and pressure in the present ocean. This behavior decreases the maximum number of phases that may coexist at equilibrium in the system. Stability fields of aluminosilicates (including mixed-layer illite-montmorillonite solid solution) in a nine component model of the system can be depicted on isothermal isobaric activity diagrams. Because variables change significantly with depth and geographic position in the ocean, the equilibrium composition of the mixed-layer phase also changes, becoming less illitic with increasing depth. Quantitative consideration of equilibria in the present ocean provides a frame of reference for investigation of chemical evolution of sea water and mass transfer involved in silicate-sea water reactions through geologic time. — *from* Authors' abstract

Helmstaedt, Herwart. *See* Kumazawa, Mineo. 00123

Hendrickson, G. E. *See* Doonan, C. J. 07106

Henniger, B. R. *See* Overbey, W. K., Jr. 07088

06669 **Henry, K. W.; Opdyke, N. D.** Preliminary report on paleomagnetism of Deep Sea Drilling Project Leg 4 specimens, Chap. 22 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 439-454, illus., tables, 1970.

Paleomagnetic results from Leg 4, off Brazil and in the Caribbean Sea, were disappointing. Sampling was too sparse to allow even tentative magnetic stratigraphy to be interpreted. Declination values were not consistent, so interpretations were made

from inclination data alone. This was difficult on Leg 4 because the drilling sites were all at low latitude. The standard deviation around the mean is greater than 25°, so a change of sign of the inclination is within this deviation without being due to a polarity reversal. No conclusions were drawn from Leg 4 results except that reversals do seem to occur in all sampled geologic epochs. — ESL

Herbosch, Alain. *See* Jedwab, Jacques. 06518

Herring, Alika K. *See* Hatheway, Allen W. 07069

06767 **Hester, Norman C.** Sand and gravel resources of Sangamon County, Illinois: Illinois Geol. Survey Circ. 452, 20 p., illus., tables, 1970.

The sand and gravel of Sangamon County was deposited by glacial melt waters during the Pleistocene. Valley-train deposits in the Sangamon River valley were formed in Wisconsinan time. Terrace remnants occur east of Springfield along the river. West of Springfield the terrace was partially buried by Holocene flood-plain deposits of the Sangamon River. Hills and ridges of sand and fine gravel in northeastern Sangamon County may be related to the ice that advanced into the area in Illinoian time. Sand and gravel are produced from river terrace remnants east of Springfield and from deposits beneath the Holocene river sediments. Resource-quality deposits occur in other parts of the county. — *from* Author's abstract

07019 **Hester, Norman C.; Pryor, Wayne A.** A detailed study of lithified specimens of *Ophiomorpha* [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 576, 1970.

07020 **Hewins, R. H.** Microprobe studies of the base of the Sudbury nickel Irruptive, Ontario, Canada [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 576-577, 1970; Econ. Geology, v. 65, no. 6, p. 637-638, 1970.

07021 **Hewitt, David A.** The metamorphism of micaceous limestones [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 577, 1970.

Heyman, Louis. *See* Kelley, Dana R. 06534

00168 **Higashi, Akira; Corte, Arturo E.** Solifluction — A model experiment: Science, v. 171, no. 3970, p. 480-482, illus., 1971.

Laboratory experiments that subjected soil to repeated freeze-thaw cycles in an inclined container revealed every process of solifluction, especially of frost creep. Multiple slope-angle effects on the amount of particle movement on the soil surface in every cycle are interpreted by several characteristic processes of frost creep. Gelifluction was found to occur in thicker layers of soil, owing to the excess water retained in soil after thawing. For further development of the problem, a similarity law for the model experiment was derived from thermal considerations. — Authors' abstract

06571 **Higgins, Anthony K.** On some ice-dammed lakes in the Frederikshaab district, South-West Greenland [with Danish abs.]: Dansk Geol. Foren Medd., v. 19, no. 4, p. 378-397, illus., table, 1970.

Three ice-dammed lakes in the Frederikshaab district which periodically empty by subglacial drainage are described. All available observations of their water levels and time of drainage are recorded. Two of the lakes drain regularly, annually. The third lake drains at two to three year intervals. Drainage of two of the lakes appears to be initiated by hydrostatic uplift of the ice dam, and in the case of the third lake plastic flow at the base of the ice dam may also be a contributary factor. Various aspects of the drainage of ice-dammed lakes are discussed. — Author's abstract

06615 **Hill, Donald Gardner.** A laboratory investigation of conductivity and dielectric constant tensors of rocks [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 767B-768B, 1970.

06570 **Hill, Mary R.** Barrier beach: California Div. Mines and Geology Mineral Inf. Service, v. 23, no. 12, p. 231-233, illus., 1970.

Formation of tidal inlets in a barrier bar protecting Rodeo Lagoon in Marin County, Calif., from the Pacific Ocean, was studied during the winters of 1966-67 and 1967-68, using time-lapse photography. Changes observed were: alterations in shape and size of the lagoon, and in configuration of the bar, and formation of inlets. During high tide storm waves easily overtopped the barrier, and tidal inlets formed six times. Winds impounded water only in the second stage of the storm. The channel cut first, at the north end of the bar, is the low point, and may represent the course of a Pleistocene creek. No sand was observed being carried by the sea to the land, but a great deal was carried seaward when impounded waters rushed out. Inlets persisted for only a few hours or days. — ESL

07022 **Hilpman, Paul L.** Geology teachers and environmental education [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 577-578, 1970.

06718 **Hirasawa, Tomowo.** Focal mechanism determination from S wave observations of different quality: Jour. Physics Earth, v. 18, nos. 3-4, p. 285-294, illus., tables, 1970.

A least squares method is derived for the focal mechanism determination from S-wave observations (polarization angles) of different quality. Some considerations are made on how to determine a weighted value appropriate to each observation. As one of the numerical examples, a least squares solution is obtained for the southeastern Nevada earthquake of August 16, 1966, which occurred near the Nevada Test Site. This S-wave solution, represented by pure strike-slip motion, satisfies well the observed initial motions of P-waves; the tension axis trends S. 34° E. (±4°) nearly on the horizontal plane. — *from Author's abstract*

Hoagland, Alan D. *See* Gilbert, Ray C. 06990

06586 **Hoekstra, Karl Egmond.** Crystal chemical considerations of the spinel structural group [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 569B, 1970.

Hoffman, Buren W. *See* Kuykendall, W. E., Jr. 06664

06872 **Hofmann, Albrecht Werner.** Hydrothermal experiments on equilibrium partitioning and diffusion kinetics of Rb, Sr, and Na in biotite — Alkali chloride solution systems [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 250B-251B, 1970.

06623 **Hofmann, R. B.** Geodimeter and laser ranging measurements across the San Andreas fault system, *in* Laser applications in the geosciences (J. Gauger and F. F. Hall, Jr., editors) — Symposium, Huntington Beach, Calif., 1969, Proc.: North Hollywood, Calif., Western Periodicals Co., p. 131-150, illus., 1970.

Amplitude modulated narrow-band arc light and monochromatic laser light transit times have been used to measure fault movements in California. Movement on the San Andreas system has been observed to vary in time and place; variations with time at a particular place have been shown to often precede earthquakes of M = 4.5-5.5. Where the fault moves regularly, variations consist of fault sticking until several centimeters of strain are stored. Where the fault has not moved regularly during the past 10 years, evidence indicates general compression of the area; compression events of about six months' duration and of about 10-15 cm over 20 km precede earthquakes in these areas. Variations in atmospheric index of refraction are currently corrected with temperature, pressure, and humidity data taken at ends and midline, by balloon, of the distance being measured. Developments in dual color laser promise higher accuracies. — *from* Author's abstract

06638 **Hogarth, D. D.; Brown, F. F.; Pritchard, A. M.** Biabsorption, Mössbauer spectra, and chemical investigation of five phlogopite samples from Quebec: Canadian Mineralogist, v. 10, pt. 4, p. 710-722, illus., tables, 1970.

Five samples of phlogopite from intrusive carbonates and vein-dykes of the Gatineau district were studied by means of biabsorption, Mössbauer spectra and chemical analyses. Comparison of optical data and Mössbauer spectra shows that, in samples which exhibit reverse optical absorption, there is a significant amount of ferric iron in tetrahedral sites. The unmistakable Mössbauer absorption at 0.66 mm/sec, which usually appears as a wing on the high-velocity side of the low-velocity peak of high-spin Fe^{2+}, provides an easy and reliable method for quantitative estimation of Fe^{3+}_{IV}. Chemical analyses tend to produce somewhat high Fe_2O_3 values and in one sample (203) Mössbauer studies suggest some of the ferric iron is present as impurity.— Authors' abstract

07023 **Hogarth, David D.** Petrology of lapis lazuli, Soper River, Baffin Island [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 578-579, 1970.

07024 **Holbrook, Sally Jean; Bambach, Richard K.** Budding, growth, and environmental response in *Favosites helderbergiae* hall (tabulata) [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 579, 1970.

06813 **Hole, F. D.** Drumlin morphology and soil relationships in Jefferson County, Wisconsin, Pt. F *in* Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, p. F1-F9, illus., table, 1970.

This paper is based on an M.S. thesis by R. J. Allen (1967), under the direction of the author, which consisted of a statistical analysis of the Jefferson County drumlins in southern Wisconsin. The origin of fines in drumlin soils was also investigated. Dimension, orientation, and arrangement of drumlins was obtained from U.S. Geological Survey topographic maps (scale 1:24,000). Particle-size distribution and carbonate content of till and soils were determined in the laboratory for samples from 24 drumlins. Results are shown in graphs and tables. The statistical model of a drumlin is a streamlined hill about 3/5 of a mile long, 1/5 of a mile wide, and 50 feet high. No relation was found between drumlin dimension and till texture. The cluster arrangement of drumlins may reflect pre-drumlin distribution of materials and subglacial landforms, the original pattern of ice movement, or a modification of the original pattern of drumlins brought about by meltwater erosion. — EH

Hole, Francis D. *See* Black, Robert F. 06810

06836 **Hole, Thornton J. F.; Redmond, Charles E.** Florence valley, an abandoned stream valley, Florence Township, Erie County, Ohio: Ohio Jour. Sci., v. 70, no. 6, p. 341-346, illus., 1970.

The abandoned Florence Valley is about one mile long and connects the valleys of Chappel Creek and Vermilion River. There is evidence that Florence Valley was formed as a result of the capture of a tributary of the Vermilion River by Chappel Creek. Chappel Creek, at the junction of Florence Valley and the valley of Chappel Creek, has a right-angled bend, which displays morphology characteristic of an "elbow-of-capture." The gradient of the eastern two-thirds of Florence Valley slopes toward Vermilion River. Because the Vermilion River is more deeply entrenched than is Chappel Creek, this stream capture must have taken place at a time when base level was at a higher elevation, when Chappel Creek had a shorter course and steeper gradient than did the Vermilion River. These conditions are believed to have existed during the time of Lake Maumee III. — *from* Authors' abstract

06577 **Hollister, Lincoln S.** Origin, mechanism, and consequences of compositional sector-zoning in staurolite: Am. Mineralogist, v. 55, nos. 5-6, p. 742-766, illus., tables, 1970.

Sector-zoning phenomena in staurolite appear to be an interrelation of chemical equilibrium between surfaces, rate of growth, and rates of diffusion perpendicular to the surface layers. The diffusion process is in response to a thermodynamic drive toward bulk chemical equilibrium. Strongly sector-zoned staurolite appears to occur when the growth rate exceeds the diffusion rates perpendicular to the growth layers.

The mechanism leading to the observed differences in chemistry between sectors can be understood in terms of the two-dimensional atomic configuration on the crystal faces. The coupled substitution of (3Al) for (2Si+H), leading to excess Al on the (001) face, is possible, whereas it cannot occur easily on the (010) face. The coupled substitution of (Mg+Ti) for (2Al) is easily available on the (010) face, whereas it is not so available on the (001) face. — *from* Author's abstract

07025 **Holloway, John R.** Fluid compositions in basalt-H_2O—CO_2 system [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 579-580, 1970.

06599 **Holmgren, Dennis Arthur.** Columbia River basalt patterns from central Washington to northern Oregon [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 759B, 1970.

07026 **Holser, William T.; Anderson, Roger Y.** Bromide distribution in Castile halites, Delaware basin, Texas [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 580, 1970.

07027 **Hooke, Roger LeB.** Geomorphic evidence for late-Wisconsin tectonic deformation, Death Valley, California [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 580-581, 1970.

00127 **Horai, Ki-iti.** Thermal conductivity of rock-forming minerals: Jour. Geophys. Research, v. 76, no. 5, p. 1278-1308, illus., tables, 1971.

In a new method to measure thermal conductivity of monomineralic aggregate at ordinary temperature and pressure the needle-probe technique is applied to a mixture of powdered specimen and distilled water. Thermal conductivity of 166 rock-forming minerals has been determined, and results are discussed in relation to density, crystal structure, and chemical composition. Major conclusions are: for most minerals, thermal conductivity is a linear function of density for constant mean atomic weight; conductivity of silicates is controlled by structure of the silicon-oxygen network and is lower for more complicated networks; in an isomorphous series, thermal conductivity decreases as mean atomic weight, or mass of metallic ions, increases; in a series forming a binary solid solution, conductivity is minimum at an intermediate composition; thermal conductivity of silicates is related linearly to elastic-wave velocities. — *from* Author's abstract

Horne, John C. *See* Wanless, H. R. 06708

06684 **Horton, R. E.** Erosional development of streams — Quantitative physiographic factors, [Chap.] 5 *in* Rivers and river terraces (G. H. Dury, editor): London, Macmillan and Co. Ltd., p. 117-165, illus., tables, condensed 1970; originally published 1945.

The problem of erosional morphology is approached quantitatively, using a system of stream orders in which unbranched finger-tip tributaries are order 1, and the main stream is the highest order. Factors involved in determining drainage densities, length of overland flow, and stream frequency are included. The phrase, 'composition of a drainage net,' as distinguished from drainage pattern is coined. Laws of drainage composition discussed include those of stream numbers, stream lengths, and slopes; stream valleys in New York are used as illustrations. Physiographic factors for drainage basins and relation of geologic structure to drainage composition are discussed, and illustrated by creeks in Pennsylvania. Surface erosion by overland flow, origin and development of stream-system valleys by aqueous erosion, and the drainage-basin topography are examined. The paper was published originally in Geol. Soc. America Bull., v. 56, no. 3, p. 275-370, 1945). — ESL

07028 **Hoskins, Earl R.; Hammerquist, Donald W.; Rahn, Perry H.** The use of aerial photography of delineate areas of highway distress in western South Dakota [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 581, 1970.

06686 **Hospers, J.; VanAndel, S. I.** A review of selected palaeomagnetic data from Europe and North America and their bearing on the origin of the North Atlantic Ocean,

Chap. 30 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 263-275, illus., tables, 1970.

A selection of paleomagnetic data, in which the prime concern is to select data which have been subjected to demagnetization tests, yields a number of well-defined pole positions for Europe and North America which demonstrate that Europe and North America have significantly different polar wandering curves, clearly in favor of continental drift. Results confirm the fit of the Atlantic edges of the European and North American continents obtained by Bullard et al. (1965) on the basis of continental slope topography. The time cannot be determined exactly, but it appears that the opening of the North Atlantic Ocean began in Late Permian or Mesozoic times. — *from* Authors' conclusions

07029 **Hovis, Guy L.; Waldbaum, David R.; Thompson, James B., Jr.** Calorimetric studies of Al-Si ordering and Na-K mixing in monoclinic alkali feldspars [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 582, 1970.

07030 **Howe, Robert C.** "Geohumanities" and teaching introductory geology [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 582-583, 1970.

Hower, John. *See* Perry, Ed. 06914

00119 **Hsü, K. Jinghwa.** Franciscan mélanges as a model for eugeosynclinal sedimentation and underthrusting tectonics: Jour. Geophys. Research, v. 76, no. 5, p. 1162-1170, illus., 1971.

Eugeosynclinal rocks are commonly tectonic mixtures of rocks derived from more than one realm of deposition. The Franciscan mélange, which includes mid-ocean ridge ophiolites, abyssal plain radiolarites, and deep-sea trench flysch turbidites, was pervasively sheared when the North American plate rode over a Cretaceous Neo-Franciscan plate. The plate junction is not a single overthrust surface. Shear surfaces within the mélange signify a westward migration of the plate junction during underthrusting. The glaucophane schists record a pre-Cretaceous Franciscan history; once deeply buried, they were squeezed out during Late Jurassic alpine deformation (Nevadan orogeny), when the North American continent collided with a microcontinent (Salinia). Cretaceous underthrusting along a consuming plate margin resulted in melange deformation and lowsonite-schist metamorphism of the neo-Franciscan rocks, which are coeval with the Great Valley sequence. — DBV

06481 **Hsu, Mao-Yang; Clifford, Paul M.** Deformation of the Seine conglomerate in the Rainy River area, Ontario [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 20-21, 1970.

06849 **Hubbard, Norman J.; Gast, Paul W.; Wiesmann, Henry.** Rare earth, alkaline and alkali metal and Sr-87:Sr-86 data for subsamples of lunar sample 12013: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 181-184, illus., table, 1970.

Four subsamples of lunar rock 12013 have been analyzed. The "whole rock" sample has high rare earth and very high Ba concentrations with the chondrite normalized abundance pattern showing a slight enrichment in Ba and Ce and the usual large negative Eu anomaly. The light and dark components of this rock have similar REE. The light colored materials are commonly quite enriched in radiogenic Sr-87 and the Rb-Sr system appears to have lost Rb. — Authors' abstract

06511 **Huebner, J. Stephen; Sato, Motoaki.** The oxygen fugacity-temperature relationships of manganese oxide and nickel oxide buffers: Am. Mineralogist, v. 55, nos. 5-6, p. 934-952, illus., tables, 1970.

The temperature-oxygen fugacity relationships of the "oxygen buffer" assemblages Ni-NiO, Mn_3O_4-Mn_2O_3, and $Mn_{1-z}O$-Mn_2O_4 have been determined at 1 atm total pressure by an electrochemical method over the temperature ranges 519°-1319°, 594°-952°, and 771°-1202°C, respectively. Equations are given. These equations will

be useful for hydrothermal experimentation and metamorphic petrogenesis where a knowledge of existing oxygen fugacities is necessary. — *from* Authors' abstract

06482 **Hutchinson, R. W.** Mineral potential in greenstone belts of northwestern Ontario [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 22-23, 1970.

06721 **Hwang, Li-san; Lin, Albert C.** Experimental investigations of wave run-up under the influence of local geometry, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 407-425, illus., tables, 1970.

This paper presents the results of three sets of experiments investigating the effect of local geometry of wave run-up. The first set was designed to investigate the effect of harbor oscillation — under periodic wave excitation — on run-up; the second investigated the effect of harbor oscillation — under nonperiodic wave-train excitation — on run-up; finally, the third set investigated run-up in a three-dimensional bay. A detailed discussion of the influence of wave period and geometric location of wave run-up is presented, and explanations are given for the scattering of results of field observation of tsunami run-up along a coast. — Authors' abstract

Iagmin, Paula J. *See* Desborough, George A. 06897

00187 **Ichiye, Takashi.** Continental breakup by nonstationary mantle convection generated with differential heating of the crust: Jour. Geophys. Research, v. 76, no. 5, p. 1139-1153, illus., 1971.

It is assumed that the crust contains horizontally different amounts of radioactive materials as a heat source, producing horizontal temperature differences. Time deviatives can be neglected in the equation of motion but not in the heat-transfer equation. As a first approximation the heat source is considered to be stationary in space. The problems treated are the development of convection cells by increasing horizontal difference in radioactive heating in the proto-crust, shear and tensile stresses at the upper boundary of these cells, and velocity distribution and other geometric features of the cells. A pair of major cells about 10^4 km long are developed below the protocontinent, with a rising limb beneath the center; secondary cells with speed less than half that of primary cells are formed outside each primary cell. Shear stress reaches 10^8 sq cm per sq sec about 200 m.y. after start of differential heating, yielding the breaking point of the crust materials. — DBV

07031 **Imbrie, John; Broecker, Wallace S.** Wisconsin climates recorded in Atlantic deep-sea cores [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 584, 1970.

06859 **Inouye, George T.; Bernstein, Hyman; Gaal, Robert A.** Electromagnetic depth sounder: IEEE Trans. Geosci. Electronics, v. GE-8, no. 4, p. 336-343, illus., 1970.

An advanced electromagnetic technique for deducing depths of water tables as well as conductivities of subsurface strata is described. Interpretation of field data from the Dale Dry Lake area, Calif., is in good agreement with geologic well data. The technique consists of adapting a curve-matching process to the "two-coil tilt angle method;" variables used were tilt angle as a function of frequency with coil-coil spacing as the parameter. Water-table depths at 10 and 30 feet have been uniquely deduced as well as conductivities of the ground-water and upper-layer overburden. In addition, the interpretation scheme facilitates establishment of the most sensitive operating parameters for deducing a given depth of ground water. For at least two two-layer cases, the investigation demonstrates that depth to a conductivity discontinuity can be uniquely determined. — *from* Authors' abstract

00164 **Irvine, B. M.** How to evaluate stacking velocities: Oil and Gas Jour., v. 69, no. 4, p. 92, 94-96, illus., 1971.

Optimum use of seismic records for producing a stacked seismic section requires that interpretational decisions be made concurrent with the flow of data processing. This paper describes a systematic data evaluation procedure used in processing the large volume of records obtained in a marine operation, emphasizing velocity-analysis technicues. — WBC

06780 **Ishihara, Kenji.** Development of failure around excavated slopes — Discussion [of paper 7162 by Peter Dunlop and James M. Duncan, 1970]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 2152-2153, 1970.

Paper 7162 was published ibid., v. 96, no. SM 2, p. 471-493, 1970; *see* Abs. North American Geology, January 1971.

06886 **Ishii, Hiroshi.** Reflected wave propagation in a wedge [abs]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 258B-259B, 1970.

07032 **Isphording, Wayne C.; Lamb, George M.** Age of the Citronelle Formation, an end to a controversy [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 584-585, 1970.

07033 **Isphording, Wayne C.** Epeirogeny and clay mineral facies in the Gulf Coast geosyncline [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 585, 1970.

06547 **Ito, H.; Fuller, M.** A paleomagnetic study of the reversal processof the geomagnetic field, Chap. 15 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 133-137, illus., 1970.

A preliminary account is given of an apparent magnetic field reversal recorded by natural remanent magnetization of quartz diorite stock, Laurel Hill, in the vicinity of Mount Hood, Oregon. Samples show reversed, intermediate, and normal polarity and provide a relatively complete record of a field reversal. Transition from reverse to normal occurred at 8.2 ± 0.5 m.y. — VSN

06580 **Ito, Jun; Arem, Joel E.** Idocrase — Synthesis, phase relations and crystal chemistry: Am. Mineralogist, v. 55, nos. 5-6, p. 880-912, illus., tables, 1970.

Phase syntheses of Mg-idocrase indicate the composition range of the mineral. Pressure-temperature stability fields under pure water in the sodium-free system are wide. With water pressures of 2 kbar, idocrase is stable from 450° to 720°C. The mineral associations of idocrase can be illustrated as follows: 2 grossularite plus 2 diopside plus wollastonite plus calcite plus 2 water react reversibly to form idocrase plus 2 quartz plus CO_2. The presence of three mineral zones at Crestmore, Calif., is best explained in terms of compositional change rather than by P-T variation. Qualitative kinetic studies show that the rate of growth and nucleation of idocrase are strongly dependent on temperature and pressure. — *from* Authors' abstract

07034 **Ito, Keisuke; Kennedy, George C.** The basalt-eclogite transition and the structure of the upper mantle [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 586, 1970.

J. V. *See* Lamar, D. L. 06543

07035 **Jackson, Jeremy B. C.** The ecology and paleoecology of near shore tropical Lucinacea (Bivalvia) [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 7, p. 586-587, 1970.

06862 **Jacobs, J. A.** The origin of the Earth's core, *in* Geophysical studies on the evolution of the Earth's deep interior — A symposium, Madrid, 1969, Proc.: Physics Earth and Planetary Interiors, v. 2, no. 5 (spec. issue), p. 303-310, 1970.

The origin of the Earth's core is bound up with the origin of the Earth itself and the solar system. The mechanism of accretion is examined in some detail and the origin of the Earth, the Moon, and Mars is discussed. The growth of the Earth's core is in-

vestigated — in particular the question of when this event took place and how long it took for completion. The thermal history of the Earth, its magnetic field, tectonic events at its surface, and other geophysical phenomena are reviewed in relation to the evolution of the core. [It is concluded that core evolution was comparatively rapid and occurred very early in or simultaneously with formation of the Earth.] — *from* Author's abstract

06839 **Jaffe, Leonard D.** Lunar surface — Changes in 31 months and micrometeoroid flux: Science, v. 170, no. 3962, p. 1092-1094, illus., 1970.

Comparison of pictures of the lunar surface taken 31 months apart by Surveyor 3 and Apollo 12 show only one change in the areas disturbed by Surveyor 3: a 2-millimeter particle, in a footpad imprint, that may have fallen in from the rim or been kicked in by an approaching astronaut. Vertical walls 6 cm high did not collapse and dark ejecta remained dark. No meteorite craters as large as 1.5 mm in diameter were seen on a smooth soil surface 20 centimeters in diameter; this indicates a micrometeoroid flux lower than 4×10^{-7} micrometeoroids per square meter-second at an energy equivalent to about 3×10^{-8} gram at 20 km per second. This flux is near the lower limit of previous determinations. — Author's abstract

06741 **Jarrett, Peter M.** The mechanics of landslides in Leda clay — Discussion [of paper by W. J. Eden and R. J. Mitchell, 1970]: Canadian Geotech. Jour., v. 7, no. 4, p. 504-505, illus., 1970.

This is a discussion of a paper which appeared in ibid., v. 7, no. 3, p. 285-296, 1970; Abs. North American Geology, March 1971. The author adds further experimental results to those presented concerning the Rockcliffe slide. — EH

06518 **Jedwab, Jacques; Defleur-Schenus, Muriel; Herbosch, Alain.** Mounting and polishing small quantities of minerals: Am. Mineralogist, v. 55, nos. 5-6, p. 1065-1066, 1970.

A Millipore filter which has retained micrometer-sized particles is consolidated by partial solution and subsequent evaporation of amyl acetate. The flat, hardened matrix may then be ground and polished. — Authors' abstract

07091 **Jenkins, Charles R.; Carroll, Henry C.** Mine acid drainage and associated flow fluctuations: West Virginia Acad. Sci. Proc. 1969, v. 41 (West Virginia Univ. Bull., ser. 70, no. 11-3), p. 286-293, illus., table, 1970.

The Left Fork of Little Sandy Creek, between Fellowsville and Tunnelton, W. Va., was surveyed to locate mine drainage sources. At least 30 out of 47 potential sources were found to produce acid at some time during the year. A study was made of the relation between chemical constituents and amount of acid drainage. Results of three major sources are reported. A flow meter was used in determining the relation between acid load and flow from a mine; acid load was found to be directly proportional to flow. Sulfates, iron, and aluminum were found to vary as acidity. Hardness was not closely associated to acidity concentration but generally was reduced at higher flow due to a dilution effect; pH remained relatively constant and independent of flow. A summation of conditions from individual mines was found to accord closely with conditions observed in the receiving stream. — *from* Authors' abstract

Jenkins, W. A., Jr. *See* Wermund, E. G. 06710

06483 **Jenks, William F.** Root severance and tectonic transport of orebodies in metavolcanic host rocks [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 25, 1970.

06649 **Johnson, R. H.** Estimating earthquake rupture length from *T* waves, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 253-259, illus., 1970.

Earthquake *T* waves may find application to the tsunami warning problem by being interpreted in terms of the length of rupture. This dimension is a more direct indication of the potential of an earthquake to generate a tsunami than is earthquake magnitude. Earthquake swarms within a confined region may be recognized as such by the repetition of their signature. The length of rupture of a major earthquake can be estimated from the duration of the high-level portion of the *T* phase at two or more stations. It is speculated that equivalent information may be obtained from one recording station by azimuthally tracking the incoming *T* waves. — Author's abstract

Johnson, Stephen H. *See* Mooney, Harold M. 06582

Johnson, T. C. *See* Grantz, Arthur. 07076

Johnston, G. H. *See* Brown, W. G. 06739

Johnston, R. C. *See* Brede, E. C. 06737

Joiner, Thomas J. *See* McWilliams, Richebourg G., Jr. 06690

Joiner, Thomas J. *See* LaMoreaux, Philip E. 06734

Jones, J. W. *See* Ghent, E. D. 06786

Jones, Michael L. *See* Duncan, William M. 07090

Jordaan, Jan M., Jr. *See* Williams, John A. 06652

Julian, Bruce R. *See* Toksoz, M. Nafi. 00117

06619 **Kalb, George William.** Desorption isotherms of montmorillonite-organic complexes [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 826B, 1970.

06503 **Kamb, Barclay.** Interference colors in flash figures: Am. Mineralogist, v. 55, nos. 5-6, p. 767-775, illus., 1970.

The distribution of colors in interference figures of crystal plates of arbitrarily large thickness and birefringence cannot be treated with the conventional path-difference formula that is the basis for the use of Bertin's surfaces, but the correct path-difference formula is nevertheless simple. When applied to the uniaxial flash figure, it shows that the color will always fall continuously from the center of the figure toward the optic axes, contrary to statements in some textbooks. For most biaxial flash figures, the color will decrease toward the acute bisectrix and increase toward the obtuse bisectrix. However, for a limited range of figures near $2V = 90°$, the color can at first decrease and then begin to increase subsequently toward the acute bisectrix, an effect similar to that envisaged in the textbook statements mentioned. — Author's abstract

06707 **Kanes, William H.** Facies and development of the Colorado River delta in Texas, *in* Deltaic sedimentation, modern and ancient: Soc. Econ. Paleontologists and Mineralogists Spec. Pub. 15, p. 78-106, illus., tables, 1970.

In the northeastern Colorado delta, the sequence of facies and environments from the surface down is: delta-plain and root-mottled clay and silt, 1-5 feet, with algal crusts giving way locally to massive and burrowed clays of channel-fill environment; delta-fronts sand, 2-8 feet, with small-scale crossbedding and grading laterally into finer grained sediment; prodelta reddish-brown laminated silty clays, 1-5 feet; and bay laminated and burrow-mottled silty clays and clayey silts, 10-14 feet, lying unconformably on the Pleistocene. Faunas are more variable than sediments. Two stages of delta progradation are indicated by air photos: an earlier stage of narrow lobate delta with closely spaced distributaries, and a later stage with more digitate lobe that encircles the eastern half of the earlier lobe. Subsidence of 1 to 2 feet is estimated since initial formation; locally 4 feet is documented. — *from* Author's abstract

Kanes, William H. *See* Donaldson, Alan C. 06748

Kaplan, I. R. *See* Ben-Yaakov, S. 00157

Kaplan, I. R. *See* Presley, B. J. 06667

06935 **Kashef, Abdel-Aziz I.** Model studies of salt water intrusion: Water Resources Bull., v. 6, no. 6, p. 946-967, illus., tables, 1970.

This paper is concerned only with viscous flow models of ground-water systems, but a brief summary of other types possibly useful for study of salt-water intrusion is given; some such experiments are not related to that field. Two main types are: gravity flow systems analogous to some phases of salt intrusion problems and problems in oil fields which bear general similarities to sea-water intrusion. In oil fields, gas cycling studies give valuable information to sea-water problems. — *from* Author's abstract

06549 **Kay, Marshall.** Continental margins and continental drift, Chap. 36 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 333-340, illus., 1970.

Structural-stratigraphic evidence is discussed that shows very strong correlation between tectonic belts of Newfoundland and the British Isles. The evidence supports continental drift and, although it does not show the amount of separation, it places limits on possible directions of drift and of transcurrent movements and suggests times of movements and rates of change. In Newfoundland the structural-stratigraphic belts are the Western Platform, Central Volcanic Belt, and the Avalon Platform which correspond in Britain to the Hebrides and northwest Scotland beyond the Moine Thrust, the Caledonides southeastward to the Pontesford Hill flexure, and the poorly displayed lower Paleozoic of western England, particularly Shropshire and Herefordshire, respectively. — VSN

Kazmann, Raphael G. *See* Wintz, William A., Jr. 07109

Keays, R. R. *See* Laul, J. C. 06854

07047 **Kebeasy, Rashad M.** P-wave travel time anomaly in the north and the east of circum Pacific region [with Japanese abs.]: Tokyo Univ. Earthquake Research Inst. Bull., v. 48, pt. 3, 381-397, illus., tables, 1970.

Traveltime residuals were studied for earthquakes in the Aleutian-Alaskan Arc and coastal North and South America in the period 1964 to early 1969, and were compared with those for known models to determine upper mantle structure. The SALK model, representing mantle structure beneath the Alaskan mountain range, has a P-wave velocity higher than that of the JB model in the upper 200 km, with a relatively low-velocity layer between 100-180 km. In the NALK model, representing the Aleutian-Alaska Arc region, P-wave velocity is 7.84 kmps in the depth range 33-60 km and becomes less than that of the JB model between 80-280 km. Velocity contrast between oceanic and continental regions is about 0.46 kmps; the two models are similar below 400 km. Residuals in coastal North and South America show regional difference, but no conclusion could be derived. — VSN

Keeney, D. R. *See* Konrad, J. G. 06930

06484 **Keighin, C. W.** Age and petrology of the Fort Ridgely Granite, southwestern Minnesota [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 26, 1970.

06764 **Keller, George H.; Bennett, Richard H.** Variations in the mass physical properties of selected submarine sediments: Marine Geology, v. 9, no. 3, p. 215-223, illus., tables, 1970.

Since extreme values are frequently more significant than the averages, the maximum and minimum values of selected mass properties of submarine sediments, as well as average values, have been compiled for the North Atlantic and North Pacific basins. When these values were compared with similar data from Chesapeake Bay,

Tokyo Bay, and Lake Pend Oreille in Idaho, it was found that although the ocean basin deposits exhibit greater extremes, these particular bay and lake sediments possess higher overall values. Comparison of the ocean basin data with their associated sedimentary deposits revealed some characteristic parameters for each of the three types of deposits considered (carbonates, terrigenous, red clay). It is not yet possible to classify with confidence either an area or a submarine deposit by any of these parameters. — *from* Authors' abstract

06534 **Kelley, Dana R.; Lytle, William S.; Wagner, Walter R.; Heyman, Louis.** Oil and gas developments in Pennsylvania in 1969 with ten year review and forecast: Pennsylvania Geol. Survey Prog. Rept. 181, 65 p., illus., tables, 1970.

07059 **Kempe, D. R. C.; Deer, W. A.; Wager, L. R.** Geological investigations in East Greenland — Pt. 8, The petrology of the Kangerdlugssuaq alkaline intrusion, East Greenland: Medd. Grönland, v. 190, no. 2, 49 p., illus., tables, geol. map, 1970.

The Kangerdlugssuaq alkaline intrusion, of Tertiary age, intrudes the Precambrian metamorphic complex of East Greenland. It was originally overlain by basalts, now removed by erosion, into which there was considerable stoping resulting in the incorporation of large basalt xenoliths within the outer part of the intrusion. Nordmarkites constitute 90 percent of the syenite mass which is 33 km in diameter. Quartz-nordmarkite, transitional pulaskite, pulaskite, and foyaite are also present. Rocks are cut by veins and contain pegmatite segregations. The chemistry of the main rocks is discussed, and 14 analyses are included, as well as analyses of veins, inclusions, and country rocks. The petrography of the rocks is described and modal analyses are given. — *from* Authors' abstract

Kennedy, George C. *See* Ito, Keisuke. 07034

06600 **Kent, Douglas Charles.** A preliminary hydrogeologic investigation of the upper Skunk River basin [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 759B-760B, 1970.

06601 **Kilinc, Ishak Attila.** Experimental metamorphism and anatexis of shales and graywackes [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 760B, 1970.

06594 **Kim, Jong Sol.** Load-deformation-time behavior in clays [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 730B, 1970.

07058 **Kimyai, Abbas.** Plant microfossils from the Raritan Formation (Cretaceous) in Long Island [with French abs.]: Pollen et Spores, v. 12, no. 2, p. 181-204, illus., table, 1970.

Core samples of clays of the Raritan Formation (Cenomanian) were collected from depths of 130 to 190 feet below land surface near Oak Neck on Long Island Sound, Nassau County, N.Y. The samples yielded 24 species from 22 genera of pollen and spores; four species are new: *Cingulatisporites corrugatus*, *Microreticulatisporites crassus*, *Monosulcites microreticulatus*, *Abietineaepollinites ovatus*. An attempt is made to arrange the descriptions by affinities to natural taxa of modern plants. Coniferous gymnosperm pollen (bisaccate and inaperturate) is predominant and fern spores are common; bryophyte spores and cycadophyte and angiosperm pollen are also represented. The palynomorphs are similar to those reported from the Raritan of New Jersey, but marine microfossils are absent. A subtropical to temperate climate is suggested. — VMJ

06531 **Kirkby, Edward A.** Geologic map index of Michigan, 1843-1962: Michigan Geol. Survey Circ. 8, 56 p., illus., 1970.

This index is a comprehensive listing of published maps relating to the geology and mineral resources of Michigan; areal and author indexes are included. — MCM

Knecht, Joseph. *See* Orchard, R. J. 06782

06873 **Knight, Louis Harold, Jr.** Structure and mineralization of the Oro Blanco mining district, Santa Cruz County, Arizona [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 251B, 1970.

06745 **Knopoff, L.** Models of continental drift, *in* Geophysical studies on the evolution of the Earth's deep interior — A symposium, Madrid, 1969, Proc.: Physics Earth and Planetary Interiors, v. 2, no. 5 (spec. issue), p. 386-392, illus., 1970.

Because of inhomogeneity between the upper and lower mantle, the flow in the mantle associated with continental drift must be confined to the upper mantle. This restriction makes it unlikely that a layer of fluid heated from below or from within can be the driving mechanism. A more likely mechanism is drift associated with moving heat sources. Lateral inhomogeneity of heat production in crustal matter between oceanic and continental regions is the correct magnitude to drive the continents apart. — Author's abstract

Knowles, C. E. *See* Reid, R. O. 06654

06719 **Koch, Donald L.** Stratigraphy of the Upper Devonian Shell Rock Formation of north-central Iowa: Iowa Geol. Survey Rept. Inv. 10, 123 p., illus., 1970.

Principal exposures of the Upper Devonian Shell Rock Formation occur along Shell Rock River in north-central Iowa. The Mason City, Rock Grove, and Nora members are recognized. Its areal extent is very small, and maximum thickness is 65 feet. The formation lies unconformably between Middle Devonian Cedar Valley Limestone and Upper Devonian Lime Creek Formation, with outliers of Cretaceous sandstones and shales lying unconformably upon it along its eastern margin. It consists of argillaceous limestones, dolomites, and shales, and prominent coralline and stromatoporoid biostromes, the latter predominating in the upper part, indicating successive transgressions of late Shell Rock sea. Data in this report demonstrate that the dense limestone (micrite) beds and underlying dolomite beds near Mason City correlate with Cedar Valley Limestone and that the depositional basin of the Shell Rock Formation was more restricted than thought. — *from* Author's abstract

06729 **Koch, Karl-Rudolf.** Gravity anomalies for ocean areas from satellite altimetry, *in* Marine geodesy, a practical view — Symposium on Marine Geodesy, 2d, 1969: Washington, D. C., Marine Technology Soc., p. 301-307, 1970.

Gravity anomalies for the oceans can be computed from satellite altimetry data by means of the inversion of Stokes' formula. To obtain anomalies in the continental shelf regions, more accurate formulas have to be applied which take into account the topography of the adjacent continents. It is proposed to determine the density of a simple layer distributed over the surface of the Earth as an intermediate step and then to convert the results into gravity anomalies. This approach allows one to process the tracking data of the satellite carrying the altimeter, the altimeter observations, and gravity measurements in a single least squares adjustment for density values of the simple layer. — *from* Author's abstract

Kodama, H. *See* Ross, G. J. 06790

Kojan, Eugene. *See* Twiss, Robert. 06920

07112 **Komar, C. A.; Kovach, S. J.** Directional ultrasonic pulses orient failure planes in sedimentary rocks [abs.]: West Virginia Acad. Sci. Proc. 1969, v. 41 (West Virginia Univ. Bull., ser. 70, no. 11-3), p. 303, 1970.

00156 **Komar, Paul D.** The mechanics of sand transport on beaches: Jour. Geophys. Research, v. 76, no. 3, p. 713-721, illus., 1971.

It is demonstrated by a rational derivation that the littoral drift resulting from the saw-tooth motions of sediment along a shoreline under the action of an oblique wave swash is given by the relationship $I_l = K(EC_n)_b \sin \alpha_b \cos \alpha_b$, which previously had only an intuitive foundation (I_l = immersed weight; K is a dimensionless proportionality coefficient, EC_n is energy flux, and α_b is the angle the breaking wave makes with the shoreline, evaluated at the breaker zone). — DBV

Konnert, Judith A. *See* Finney, J. J. 06500

06930 **Konrad, J. G.; Chesters, G.; Keeney, D. R.** Determination of organic- and carbonate-carbon in freshwater lake sediments by a microcombustion procedure [with French, German, and Russian abs.]: Jour. Thermal Analysis, v. 2, no. 2, p. 199-208, illus., tables, 1970.

A microcombustion procedure specific for the determination of total-, organic-, and carbonate-C in freshwater lake sediments [Wisconsin] is described. The procedure involves combustion of the sample at 650° to obtain organic-C. Total-C is obtained by combustion at 950° and carbonate-C calculated by difference. The procedure was evaluated by differential thermal analyses of representative sediments and known carbonate minerals. A procedure for the identification of dolomite in lake sediments by differential thermal analysis under CO_2 is also described. — Authors' abstract

06796 **Koons, Charles B.** JOIDES cores — Organic geochemical analyses of four Gulf of Mexico and western Atlantic sediment samples: Geochim. et Cosmochim. Acta, v. 34, no. 12, p. 1353-1356, tables, 1970.

Four abyssal sediment samples collected during the JOIDES Leg 1 cruise of the drilling vessel *Glomar Challenger* in 1968 contain low amounts of organic carbon and hydrocarbons, as compared with miscellaneous sediment samples reported in the literature. This suggests that these abyssal sediments are not likely source sediments for petroleum. — Author's abstract

06620 **Koopman, Donald Edward.** The adsorption of crystal violet lactone by kaolinite [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 826B-827B, 1970.

07083 **Kopf, Rudolph W.** Geologic names in use north of the Brooks Range, Alaska, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. Q1-Q5, table, 1970.

A compendium is given of all known published formal geologic names for named rock units north of the Brooks Range in Alaska. The lexicon is divided into rock-stratigraphic names and geologic-climatic names. The names, classification, and ages shown are those in current use. Only the more important literature sources are given; these are cited in chronologic order. — VSN

00165 **Kornfeld, Joseph A.** Mesozoic discoveries focus attention on Mississippi: World Oil, v. 172, no. 1, p. 62, illus., 1971.

Recent discoveries are increasing interest in the northwestern extension of Mississippi's prolific Mesozoic trend, extending to the common corner of Louisiana and Arkansas. The active area measures 50 miles from southeast to northwest, and 45 miles from east to west. While Lower Cretaceous Hosston, Rodessa, and Mooringsport carbonates command interest, chief geological targets are Jurassic Smackover and Cotton Valley reservoirs which generally contain more reserves. — GHD

00180 **Kornfeld, Joseph A.** Interest is high in new East Colorado oil pay: World Oil, v. 172, no. 2, p. 55, illus., 1971.

Discovery of a Cretaceous "J" sand oil field at Peoria in the western portion of the Denver Julesburg basin of eastern Colorado has accelerated drilling activity in a four-county area. Most exploratory wells are contracted to 6,500-8,000 feet. The basin was the second most active drilling play in the Rocky Mountain region in 1970. — GHD

Koropatnick, A. *See* Macpherson, J. G. 06747

06565 **Koshinsky, Gordon D.** The morphometry of shield lakes in Saskatchewan: Limnology and Oceanography, v. 15, no. 5, p. 695-701, illus., tables, 1970.

Morphometric data are presented for 68 lakes on the Precambrian Shield in Saskatchewan. The lakes have a wide range of surface dimensions but share a common history and a distinctive geologic environment. Basin form, insulosity, and lake configuration are examined in relation to lake areas and are found to be dependent. The nature of this dependency is linked to characteristics of lake origin and geology peculiar to the shield region. — Author's abstract

Kovach, S. J. *See* Komar, C. A. 07112

Krivoy, H. L. *See* Richter, D. H. 06692

06760 **Kroopnick, P.; Deuser, W. G.; Craig, H.** Carbon 13 measurements on dissolved inorganic carbon at the North Pacific (1969) Geosecs station: Jour. Geophys. Research, v. 75, no. 36, p. 7668-7671, illus., table, 1970.

Samples from 22 depths at the Geosecs station were measured for C-13 independently at Scripps Institution of Oceanography (SIO) and Woods Hole Institution of Oceanography (WHIO). The mean deviation between the two sets of data is -0.02 per mil, and the absolute deviation is 0.06 per mil. These differences are within the intralaboratory precision. A diffusion-advection model is used to estimate that the CO_2 flux is derived about 70 ± 7 percent from the dissolution of carbonate. The deep water shows a decrease in δ C-13 of 0.4 per mil and an increase in ΣCO_2 of 3 percent relative to a South Pacific profile. — Authors' abstract

00123 **Kumazawa, Mineo; Helmstaedt, Herwart; Masaki, Kazuaki.** Elastic properties of eclogite xenoliths from diatremes of the East Colorado plateau and their implication to the upper mantle structure: Jour. Geophys. Research, v. 76, no. 5, p. 1231-1247, illus., tables, 1971.

Elastic waves velocities of eclogite xenoliths from kimberlite-bearing breccia pipes in northeastern Arizona and southeastern Utah were measured at pressure to 7 kb. The data are compared with measurements on Alpine-type peridotites and associated eclogites. Most of the eclogites have velocities consistent with materials. Despite preferred orientations of pyroxenes, the velocity anisotropy of eclogites from the kimberlite-bearing pipes is considerably smaller than that normally observed in dunites and most peridotites. The reasons for the lack of a significant anisotropy in eclogites and for anisotropies expected in peridotites are discussed. The fabric of a lherzolite nodule from Mule Ear suggests a low-velocity anisotrophy. From an application of a fabric-phase diagram for orthopyroxene and olivine to the lherzolite fabric, relatively high temperatures of recrystallization of this rock are indicated. — *from* Authors' abstract

Kumbasar, Isik. *See* Finney, J. J. 06500

Kustra, C. R. *See* Franklin, J. M. 06497

06664 **Kuykendall, W. E., Jr.; Hoffman, Buren W.; Wainerdi, R. E.** 14-MeV neutron activation analysis of selected Leg 4 core samples, Chap. 16 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 371-374, table, 1970.

Each sample and standard was irradiated with 14-MeV neutrons for two minutes, and counted for two and ten minutes after cooling times of ten minutes and two hours respectively. Radioactivity from activation products of silicon, aluminum, iron, magnesium, and potassium was resolved, and the amount of each element present was computed and tabulated. — ESL

07077 **Lachenbruch, Arthur H.** Thermal considerations in permafrost, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. J1-J2, discussion, p. J2-J5, illus., 1970.

Publications (13) on thermal considerations in permafrost by Lachenbruch and his colleagues are summarized with specific references to some articles. Permafrost is defined, the range of temperature from summer to winter and its important consequences are discussed, the factors determining temperatures in permafrost below the layer of seasonal variation are summarized, and the effects of increase in mean surface temperature in the past 100 years near the Arctic coast and of bodies of water are examined. Reliable estimates of distribution of permafrost beneath the ocean and shorelines can be made theoretically; they are important in interpretation of seismic data and to engineering problems relating to oil wells, off-shore docking facilities, and pipelines. A discussion by Robert Stoneley considers the very deep permafrost (1800-2000 feet) at Prudhoe Bay. — VSN

07070 **Ladanyi, B.** The mechanics of landslides in Leda clay — Discussion [of paper by W. J. Eden and R. J. Mitchell, 1970]: Canadian Geotech. Jour., v. 7, no. 4, p. 506-507, illus., 1970.

This is a discussion of a paper which appeared in ibid., v. 7, no. 3, p. 285-296, 1970; Abs. North American Geology, March 1971. The author applies a shear strength equation to the behavior of a jointed clay mass. — EH

Lagus, Peter L. *See* Ahrens, Thomas J. 00183

Lamar, D. L. *See* Merifield, P. M. 06542

06543 **Lamar, D. L.; McGann-Lamar; J. V.; Merifield, P. M.** Age and origin of Earth-Moon system, Chap. 6 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 41-52, illus., table, 1970.

Solutions are presented of equations of tidal evolution of the Earth-Moon system for a range of assumptions consistent with present knowledge. Results are compared with growth-line counts on marine invertebrates. A computer analysis of several equations yields past values for number of days in the month and year, representing all combinations of values of the unknown parameters: lunar torque, portion of tidal friction due to body tides, and rate of change of Earth's moment of inertia. Representative curves relating past values of number of days in the month and year, and others showing variation in number of days in synodic month based on growth-line data of fossil invertebrates are given. If growth rings indicate that organisms miss days rather than count extra days, the upper value of number of days in the month and year may be the true value, and the rate of dissipation indicated by growth lines would be consistent with origin of the Earth-Moon system about 800 m.y. ago. — VSN

Lamb, George M. *See* Isphording, Wayne C. 07032

06734 **LaMoreaux, Philip E.; Raymond, Dorothy; Joiner, Thomas J.** Hydrology of limestone terranes — Annotated bibliography of carbonate rocks: Alabama Geol. Survey Bull. 94, pt. A, 242 p., illus., tables, 1970.

This annotated bibliography of worldwide literature on carbonate rocks was compiled by the Work Group on the Hydrology of Limestone Terranes of the U.S. National Committee for the International Hydrological Decade working with the Geological Survey of Alabama. It includes a table of some of the most significant symposia and work groups on carbonate rocks since 1948, and references to the geology, hydrology, geochemistry and geophysics of carbonate rocks and to selected closely related subjects. References are coded to subject, geographic location, geologic age and description. — EH

Lane, N. Gary. *See* Haugh, Bruce N. 07012

06540 **Langbein, Walter B.; Leopold, Luna B.** River meanders and the theory of minimum variance, [Chap.] 8 *in* Rivers and river terraces (G. H. Dury, editor): London, Macmillan and Co. Ltd., p. 238-263, illus., tables, conde nsed 1970; originally published 1966.

The striking similarity in physical form of curves in rivers in varied settings is the result of geometric proportions common to all; a nearly constant ratio of radius of curvature to meander length and to channel width. Meandering can be considered in two contexts, the longitudinal profile of the system, and a meandering reach. The geometry is described and analyses of six rivers with sine-generated curves and plots of channel direction are included. A comparison of meanders to straight reaches is made. This paper was published originally as U.S. Geol. Survey Prof. Paper 442-H. — ESL

06831 **Lapham, D. M.** Calciostrontianite(?): Pennsylvania Geology, v. 1, no. 9, p. 11, 1970.

X-ray patterns of so-called strontianite from the well-known mineral-collecting locality in the Keyser Limestone at Winfield, Union County, Pa., have been rechecked and found to fit more closely than that of the unusual mineral calciostrontianite, discovered by R. V. Dietrich (1960) from similar localities in Virginia, than of pure strontianite. — VMJ

Larner, Kenneth L. *See* Boore, David M. 00152

06896 **Larson, L. T.** Cobalt- and nickel-bearing manganese oxides from the Fort Payne Formation, Tennessee: Econ. Geology, v. 65, no. 8, p. 952-962, illus., tables, 1970.

Microscope and X-ray powder studies and wet and electron-probe analyses of twenty-five specimens of cobalt-nickel-bearing manganese oxides from five locations in Tennessee suggest the following: Manganese oxides formed during weathering and solution removal of the carbonate fraction of the Fort Payne Formation, along with slumping and fracturing of chert layers. Oxides, possibly in form of gels, began to nucleate in open spaces and with Co and Ni cations were adsorbed into the growing aggregates. Crystallization produced very fine-grained textural varieties of both lithiophorite and cryptomelane in which the Co and Ni content is highest. Coarsely crystalline lithiophorite with less Co and Ni may represent crystallization without an early gel stage. The best source for Co and Ni is the limestone fraction of the Fort Payne Formation. — VSN

Lasca, Norman P. *See* Black, Robert F. 06810

06812 **Lasca, Norman P.** The drumlin field of southeastern Wisconsin, Pt. E *in* Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, p. E1-E13, illus., 1970.

The approximately 1,400 drumlins mapped in southern Wisconsin, most of them deposits from the Green Bay glacier, are indicators of the last glacial movement. Shape, size, orientation and composition of the drumlins are described. The author reviews geologic literature on the origin of drumlins and on till fabrics, and concludes that the theory proposed by Smalley and Unwin (1968) may account for drumlin distribution in southeastern Wisconsin. The theory attributes drumlin origin to special, subglacial conditions leading to shear deformation of till underlying ice when an intermediate stress level develops at the ice-till interface in a zone between the ice margin and the thicker, upglacier areas. The Jefferson County drumlins are described as examples of the preceding features. — EH

06909 **Lasca, Norman P.** The Pleistocene geology of southeastern Wisconsin, an introduction, Pt. B *in* Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, p. B1-B7, illus., table, 1970.

The author briefly summarizes the Quaternary geology of southeastern Wisconsin and presents a classification, based on subdivisions recognized by previous scientists, of the Pleistocene deposits which are primarily Wisconsinan in age. He describes the following substages: Altonian, Farmdalian, Woodfordian, Twocreekan, Valderan, and mentions the Post-Valderan period. — EH

06910 **Lasca, Norman P.** Pleistocene geology from Milwaukee to the Kettle Interlobate Moraine, Pt. C *in* Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, p. C1-C14, illus., 1970.

Color variations, iron oxide and carbonate content and magnetic susceptibility of the Valderan "red drift," or red pebbly clay, and the Woodfordian drift, which ranges in color from bluish buff to yellowish brown, are discussed. Differences in color may be due to chemical weathering or to sediment from different source areas and may not be a basis for time separations. A stratigraphic section of Woodfordian to Recent deposits was studied at the Ernst Brothers sand and gravel pit at Valders, Wis. A lower buried forest, radiocarbon dated at 12,000 ± 190 yr B.P., corresponds to Twocreekan age, and an upper forest, not dated but presumed to be Recent, are separated by pond sediments whose flora and fauna are discussed. Research on the Kettle Interlobate Moraine is reviewed and summarized. — EH

Laughon, Robert B. *See* Anthony, John W. 06574

06854 **Laul, J. C.; Keays, R. R.; Ganapathy, R.; Anders, E.** Abundance of 14 trace elements in lunar rock 12013,10: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 211-215, illus., table, 1970.

Seven samples were analyzed by neutron activation for Ag, Au, Bi, Br, Cd, Co, Cs, Ga, In, Ir, Rb, Se, Tl, and Zn. Traces of the meteorite which produced the breccia seem to be present in 3 samples. Rb, Cs, Tl, and Cd vary 5- to 20-fold among samples and correlate with each other and K. Interelement ratios are nearly constant and fit the trend of other Apollo 11 and 12 rocks. Au and Br both correlate with Zn, with a slope greater than 1. These correlations imply a local rather than highland origin for rock 12013,10. The Tl:K and K:U ratios show the Tl is depleted on the lunar surface relative to the Earth's crust. Judging from the mean Rb, Cs, and U abundances, about 12 percent of the material like rock 12013,10 would have to be added to Apollo 12 basalts to account for the high Rb, Cs, U content of the 12070 soil. — *from* Authors' abstract

06777 **Lee, Kenneth L.; Morrison, Ross A.** Strength of anisotropically consolidated compacted clay: Am. Soc. Civil Engineers Proc., v. 96, paper 7703, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 2025-2043, illus., tables, 1970.

A series of comparative anisotropically and isotropically consolidated triaxial compression tests were performed on saturated undrained specimens of compacted kaolinite and a compacted silty clay using consolidation pressures ranging from 15 psi to a maximum of 2,000 psi. Considerable differences were observed in the nonfailure stress strain and pore pressure response of the samples consolidated to different anisotropic stress conditions. However, unique relations were observed for the effective stress Mohr envelopes, the water content versus the major principal consolidation stress, and the undrained peak strength versus water content at failure. These relations were different for the different soils, but for each soil they were independent of the principal stress ratio during consolidation, and of the initial compaction water content. — ASCE abstract

06743 **Lee, W. H. K.** On the global variations of terrestrial heat-flow, *in* Geophysical studies on the evolution of the Earth's deep interior — A symposium, Madrid, 1969, Proc.: Physics Earth and Planetary Interiors, v. 2, no. 5 (spec. issue), p. 332-341, illus., tables, 1970.

Over 3,500 measurements of surface heat-flux have been catalogued and analyzed to study the large-scale variations of terrestrial heat-flow. It was found that heat-flow values are correlated with major geologic provinces: higher averages and scattered values in active tectonic regions, and lower averages and more uniform values in stable areas. Analyzing the data in the light of new global tectonics shows that the variations of heat-flow are consistent with the hypotheses of sea-floor spreading and plate tectonics. The observed heat-flow across the mid-oceanic ridges can be accounted for by a simple model of a spreading sea floor. — Author's abstract

Leeds, David J. *See* Fischer, Joseph A. 06977

06931 **Lennox, D. H.; Vandenberg, A.** Geohydrologic boundary envelopes: Jour. Hydrology, v. 12, no. 1, p. 48-52, illus., 1970.

Analysis of drawdown data for an observation well in a semi-infinite aquifer gives a one-parameter family of straight lines, each of which, in the absence of supplementary geologic or hydrologic evidence, defines a possible boundary location. The curve to which all members of the family are tangent is an ellipse and is called the geohydrologic boundary envelope. This ellipse may be useful in considering the significance of nonresponsive observation wells or in using supplementary geologic data to determine the position of a boundary. — Authors' abstract

Leopold, Luna B. *See* Wolman, M. Gordon. 06538

06539 **Leopold, Luna B.; Wolman, M. Gordon** River channel patterns, [Chap.] 7 *in* Rivers and river terraces (G. H. Dury, editor): London, Macmillan and Co. Ltd., p. 197-237, illus., tables, condensed 1970; originally published 1957.

Braided and straight channels and the interrelation among them is the subject of this paper (originally published as U.S. Geol. Survey Prof. Paper 282-B). The Horse Creek-Green River confluence, Wyoming, is selected as a type locality for a braided or anastomosing stream. Stages in its development are described, and tested experimentally in a flume. Divided and undivided reaches in the flume study are compared with those in natural rivers. Straight channels are so rare among natural rivers as to be almost nonexistent. A reach of Valley Creek near Downington, Pa., is straight for 500 feet in 30 feet of alluvium. Ratio of thalweg length to valley length is 1.0. The thalweg wanders back and forth though the channel is straight. The continuum of channels of different patterns, the nature of channel adjustment to independent controls, and observations of adjustments in natural channels are discussed. — ESL

Leopold, Luna B. *See* Langbein, Walter B. 06540

Levine, J. *See* Boyne, H. S. 06627

06628 **Levine, J.** Analysis of data from a laser strainmeter using fast Fourier transforms, *in* Laser applications in the geosciences (J. Gauger and F. F. Hall, Jr., editors) — Symposium, Huntington Beach, Calif., 1969, Proc.: North Hollywood, Calif., Western Periodicals Co., p. 227-245, illus., 1970.

A 30-meter laser interferometer located in the Poorman's Relief Mine west of Boulder, Colorado, has been used to study the seismic disturbances generated by the nuclear explosion Boxcar and the subsequent earthquake in the Gulf of California, both of which occurred on 26 April 1968. Significant differences are observed in the rise time of the first motion which is much faster in the case of the nuclear explosion, and in the surface wave to body wave amplitude ratio which is larger for the earthquake. — Author's abstract

Lewis, Brian T. R. *See* Dorman, LeRoy M. 06958

06579 **Lewis, John F.** Chemical composition and physical properties of magnetite from the ejected plutonic blocks of the Soufrière Volcano, St. Vincent, West Indies: Am. Mineralogist, v. 55, nos. 5-6, p. 793-807, illus., tables, 1970.

An homogeneous magnetite containing 6 percent Al_2O_3, 4 percent MgO and 7 percent TiO_2 by weight is present in the ejected plutonic blocks of the Soufrière, St. Vincent. The cell size of 8.372 ± 0.002 A appears to be the smallest yet recorded for a magnetite which is not cation deficient. Reflectivity values are appreciably lower and microindentation hardness readings (VHN) appreciably higher than those for pure magnetite. Magnetic properties have also been determined, and it is concluded that it is not possible to satisfactorily deduce the composition of a magnetite from measurements of cell size and Curie temperature. — Author's abstract

06617 **Liao, Kao Hsiung.** Statistical models of porous media and other hydrological systems [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 790B, 1970.

06602 **Lifshin, Arthur.** Element migration across granitic dikes [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 760B, 1970.

Lin, Albert C. *See* Hwang, Li-san. 06721

Lin, Jia-Wen. *See* Crosson, Robert S. 00151

06769 **Lindström, Maurits.** A suprageneric taxonomy of the conodonts: Lethaia, v. 3, no. 4, p. 427-445, illus., 1970.

The new suprageneric classification of conodonts here outlined is based on the essential features of natural assemblages and discrete elements and on geological occurrence and probable evolutionary lines. The conodonts are divided into the orders Westergaardodinida (new) and Conodontophorida (condonts proper). The latter is divided into 8 superfamilies: Distacodontacea, Chirognathacea, Prioniodinacea, Prioniodontacea, and Polygnathacea, with names transferred from established families; and Panderodontacea, Bryanodontacea, and Gondolellacea, which are new. Of 21 families, 12 are new. Phylogeny of the Conodontophorida (Upper Cambrian-Triassic) is diagrammed. Pertinent literature is reviewed briefly under each taxon, and genera are listed under each family (or subfamily). Most of the literature reviewed here is by American authors and deals with conodonts of the east-central and western interior U.S. — VMJ

06934 **Lineback, Jerry A.** Stratigraphy of the New Albany Shale in Indiana: Indiana Geol. Survey Bull. 44, 73 p., illus., 1970.

The New Albany Shale in Indiana is composed of dolomitic and siliceous brownish-black carbon-rich shale, greenish-gray mudstone and shale, and minor amounts of dolomite and quartzose rocks. Five lithologically distinct members are recognized. Blocher and Selmier Members appear to have equivalents in Illinois, Ohio, and Tennessee. Above the Selmier, the New Albany can be divided into several lithologic units in the subsurface, but they do not appear to be equivalent to named surface units. The Antrim, Ellsworth, and Sunbury Shales are Michigan basin equivalents of the New Albany, and the Ellsworth extends into the Illinois basin. Biostratigraphic studies indicate that New Albany deposition began in late Middle Devonian and ended in middle Kinderhookian, in a marine environment under deoxygenated conditions, resulting in accumulation of organic matter. Water depth during deposition in southeastern Indiana was less than 200 feet. — *from* Author's abstract

Lineback, Jerry A. *See* Gross, David L. 06999

07045 **Loeblich, Alfred R., Jr.; Tappan, Helen.** *Thysanoprobolus*, a new acritarch genus from the Early Devonian (Late Gedinnian) Haragan Formation of Oklahoma, U.S.A.: Biol. Soc. Washington Proc., v. 83, no. 24, p. 261-266, illus., 1970.

Thysanoprobolus polykion, n.gen., n.sp., is common in insoluble residues from a calcareous shale layer in the lower part of the Haragan Formation, from exposures in the Arbuckle Mountains west of Clarita, Coal County, Okla.; it should be an excellent stratigraphic marker for that horizon. The new species is a small (32-42μ diam) acritarch with subangular to subcircular central body and characteristic numerous short, thick conical processes with distal end truncated and crowned by a tuft of small, flexible spines. As in *Microhystridium* Deflandre, there is no differentiation of wall between the central body and the processes. No pylome is observed. — VMJ

Logan, John M. *See* Handin, John W. 07006

06561 **Lord, Harry C., 3d.** Retention coefficients and thermal release profiles of ion-injected argon from silicates and iron: Canadian Jour. Physics, v. 48, no. 1, p. 1472-1479, illus., tables, 1970.

Thermal release profiles and retention coefficients of injected argon ions were investigated as functions of substrate composition and prior ion-irradiation history. Samples of forsterite, enstatite, oligoclase, obsidian, and cold-rolled steel were irradiated with various sequences of 1 keV H^+, 4 keV He^+, and 40 keV Ar^+. The

release temperature of the maximum argon concentration was found to be a function of incident Ar^+ dose and pre-irradiation history but not substrate composition. The hydrogen or helium pre-irradiation converted the volume diffusion argon release to a low-temperature defect diffusion release. An increase in the incident dose of Ar^+ ions resulted in increasing the percentage of the argon released by defect diffusion, and also decreased the argon retention coefficient. — Author's abstract

Lower, John H. *See* Ahrens, Thomas J. 00183

06861 **Lubimova, E. A.** (organizer). Geophysical studies on the evolution of the Earth's deep interior — A symposium, Madrid, 1969, Proc.: Physics Earth and Planetary Interiors, v. 2, no. 5 (spec. issue), p. 303-398, illus., tables, 1970.

This symposium was held jointly by the International Association of Seismology and Physics of the Earth's Interior and the International Association of Geomagnetism and Aeronomy at Madrid, Spain, in September of 1969. Of the 15 papers included, 8 are cited separately; one paper is in abstract form only. — VSN

06566 **Lundin, Robert F.; Newton, George D.** Ostracoda and the Silurian stratigraphy of northwestern Alabama: Alabama Geol. Survey Bull. 95, 64 p., illus., table, 1970.

Ostracodes from well cuttings furnish the first paleontologic evidence for Silurian age of subsurface rocks in northwestern Alabama; heretofore, correlations have been made by lithology and stratigraphic position. The Silurian sequence consists of two grosslithologic units, A and B, of argillaceous limestones, with total maximum thickness of about 400 feet. Thirty ostracode species (9 new, 13 unnamed) represent 19 genera and 9 families. The Pachydomellidae, Bairdiocyprididae, Bairdiidae, and Thlipsuridae dominate in abundance of individuals; the latter two families dominate in number of taxa. The faunas of unit A and unit B have in common 19 of the 30 species, suggesting no major break in sedimentation. Twenty-two of the species are known also from one or more of the Waldron, Dixon, Brownsport Formations of western Tennessee, and Henryhouse Formation of Oklahoma, indicating Wenlockian to Ludlovian age. — VMJ

00148 **Luyendyk, Bruce P.** Comments on paper by John W. Minear and M. Nafi Toksoz, "Thermal regime of a downgoing slab and new global tectonics" (1970): Jour. Geophys. Research, v. 76, no. 2, p. 605-606, illus., 1971.

For original paper, *see* ibid., v. 75, no. 8, p. 1397-1419, 1970; Abs. North American Geology, August 1970.

06551 **Lyon, John.** The search for fossil man—Cinq personnages à la recherche du temps perdu [Five persons in search of lost epochs]: Isis, v. 61, pt. 1, no. 206, p. 68-84, 1970.

This essay is concerned with the critical work of several gifted geologists in the first 40 years of the 19th century and their acceptance or eventual rejection of the then-prevailing physico-theological explanation of man's origin and age held by the serial catastrophists, Cuvier and William Buckland — that, according to Mosaic chronology, human remains could not be older than about 5,400 years (postdiluvian), and therefore could not be contemporaneous with extinct, fossil animals. In their observations of cave deposits, John McEnery, blocked by religious views, rejected contemporaneity; Jouannet rejected a catastrophic cause but was noncommittal about the age; Paul Tournal in 1828, to be joined a year later by de Serres, de Christol, and Dubrueil, concluded positively that man's coexistence with an extinct, "antediluvian" fauna was indeed possible. By 1869 this view was generally held. — VMJ

06762 **Lyon, R. J. P.** The multiband approach to geological mapping from orbiting satellites — Is it redundant or vital,: Remote Sensing Environment, v. 1, no. 4, p. 237-244, illus., tables, 1970.

Before planning to use multiband data returned from ERTS scanners (MSS and RBV) we must assess their possible use to geologists. Are we hoping for "where is it"

or "what is it" images, The author feels strongly that only the first question can be answered with our limited knowledge of field spectra from rocks and soils. The spectral quality of data from these scanners will represent a totally new view. Airborne use of parallel instruments with optical characteristics designed as closely as possible to those in the ERTS series is vital; otherwise we will be using costly redundancy for a job any one band of imagery could do. — *from* Author's abstract

Lytle, William S. *See* Kelley, Dana R. 06534

MacFarlane, I. C. *See* Forrest, J. B. 06783

06498 **Mackasey, W. O.** The Beardmore-Geraldton belt — Guide to Sturgeon River metavolcanic-metasedimentary formations, *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 69-84, illus., 1970.

This field trip with 15 stops illustrates the stratigraphy and structure of lower Precambrian metavolcanic-metasedimentary sequence 120 miles northeast of Thunder Bay. The area, part of an east-trending 60-mi-long belt, is bounded by younger granitic batholiths except on west where covered by Lake Nipigon and upper Precambrian sedimentary rocks and diabase sheets. The lower Precambrian sequence occurs along the boundary between two major east-trending, lithologic and structural units of the Superior Province: the northern Keewatin belt of predominantly metavolcanic and granitic rocks (Goodwin, 1966), and a metasedimentary-granitic complex termed Quetico belt (Stockwell, 1964); their age relations are disputed. Mineral potential of the area includes iron as the first attraction and then gold near Beardmore; interest in iron, pyrite, and metal sulfides is continuing. — GDC

06860 **Mackay, J. Ross.** Disturbances to the tundra and forest tundra environment of the western Arctic [with French abs.]: Canadian Geotech. Jour., v. 7, no. 4, p. 420-432, illus., 1970.

The more important physical disturbances to the tundra environment are discussed with examples. Thermokarst subsidence, not thermal erosion, is shown to be the dominant result of man-induced disturbances, such as those caused by bulldozing of seismic lines and firebreaks. It is shown that a clear distinction between thermokarst subsidence and thermal erosion is necessary, if the causes of the disturbances are to be prevented and minimized, or results treated. Typical surface disturbance to tundra results in a deepening of the active layer. Therefore, foreknowledge of the effect of a disturbance on deepening the active layer, together with information on the ice content of the permafrost affected, makes it possible to predict the amount of thermokarst subsidence likely to take place. Practical examples of three types of ground disturbance in N.W.T. are given: a fire near Inuvik; a patch of vegetation trampled and killed by a dog at Garry Island; and seepage down a walking trail in an ice-wedge area at Garry Island. — Author's abstract

Mackenzie, Fred T. *See* Helgeson, Harold C. 06818

Maclay, R. W. *See* Bidwell, L. E. 07049

06747 **Macpherson, J. G.; Watson, G. H.; Koropatnick, A.** Dikes on permafrost foundations in northern Manitoba [with French abs.]: Canadian Geotech. Jour., v. 7, no. 4, p. 356-364, illus., 1970.

The development of hydro-electric power within the areas of low relief of northern Canada often requires long dikes to impound a reservoir. Much of this region lies within a zone of discontinuous permafrost, and dike design must allow for foundations varying from soft alluvial materials which will settle during or shortly after construction, to frozen strata with a high ice content which will settle as the ice thaws due to heat loss from the reservoir. This paper describes the approach to design and construction of dikes for the Kettle Generating Station in northern Manitoba, and includes a description of the instrumentation installed in an attempt to correlate the

relationship between the rate of thawing of the permafrost and the rate of drainage of free water from the foundation. — Authors' abstract

Magill, Arthur W. *See* Twiss, Robert. 06920

00134 **Magnitskiy, V. A.** Geothermal gradients and temperatures in the mantle and the problem of fusion: Jour. Geophys. Research, v. 76, no. 5, p. 1391-1396, illus., 1971.

The existence of the low-velocity layer (or layers) in the uppermost parts of the mantle, at least in oceanic and tectongenic regions, is now accepted without any doubt. Different explanations for the origin of the low-velocity layers have been suggested. One suggestion has been that partial melting is the principal cause; however, this suggestion presents two problems: (1) poor knowledge of the temperature at each respective depth, and (2) discovery in some areas of high-velocity layers that are situated just above the low-velocity zones. These two problems are discussed in this paper. — Author's abstract

Maher, Louis J., Jr. *See* Black, Robert F. 06810

06811 **Maher, Louis J., Jr.** Two Creeks forest, Valders glaciation, and pollen grains, Pt. D *in* Pleistocene geology of southern Wisconsin — Geol. Soc. America, Ann. Mtg., Milwaukee, Wis., 1970, Field Trip Guide: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 15, p. D1-D8, illus., 1970.

The stratigraphy of the Two-Creeks type section in eastern Wisconsin and of the Two-Creeks forest bed contained within it is reviewed. The author uses R. G. West's terminology: "late-glacial," which includes the Two Creeks and Valders intervals and which lasted about 1,500 years, and "postglacial" for the younger deposits. He suggests tentatively that the Two Creeks interval extended from 12,500 B.P. to 11,800 B.P., and that the Valders interval ended before 11,000 B.P. This suggestion is based on dating of biotic remains in the Two-Creeks forest horizon, on palynological correlation of the Two Creeks, Valderan and early postglacial intervals and on a pollen diagram of the Ernst Brothers' site, which contains the type section of Woodfordian to Recent deposits. The author questions the presence of the Valders till in this part of Wisconsin. — EH

Malhotra, R. *See* Hanson, G. N. 06480

06733 **Mamet, Bernard L.** Carbonate microfacies of the Windsor Group (Carboniferous), Nova Scotia and New Brunswick [with French abs.]: Canada Geol. Survey Paper 70-21, 121 p., illus., 1970.

Abundant microfauna and algal microflora in these marine platform carbonates are divisible into four assemblage zones, recognizable in the Windsor type section as well as in the Antigonish, Port Hood, and Sydney regions. The microfauna generally confirms the chronostratigraphic value of the brachiopod-coral assemblages within the Windsor basin, can be related to Tethian and Arctic zonal schemes, and suggests correlation of the Windsor Group with late Visean-earliest Namurian of western Europe. Paleobiological affinities of the Windsor microfauna to the Arctic fauna are obvious; less pronounced are those to the Cordilleran, Midcontinent, and Appalachian faunas. Similarities to the Tethian realm are minimal, although enough common elements are shared with the classical Visean-Namurian fauna of Belgium and England for direct biostratigraphic correlations. — GDC

Mamet, Bernard L. *See* Armstrong, Augustus K. 07081

06485 **Mancuso, J. D.; Dolence, J. D.** Structure of the Duluth gabbro complex in the Babbitt area, Minnesota [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 27, 1970.

06639 **Mandarino, J. A.; Gait, R. I.** Molybdenite polytypes in the Royal Ontario Museum: Canadian Mineralogist, v. 10, pt. 4, p. 723-729, table, 1970.

Results of an X-ray powder study of molybdenite specimens in the Royal Ontario Museum have revealed nine additional localities for the 3R-polytype. The 2H- and 3R-polytype may occur together, even in the small amount of material required for a pattern. Intensity differences between the 3 R and 2H lines indicate that the amounts of these polytypes present vary within a single specimen and from specimen to specimen from the same locality. Thus it is difficult to derive any genetic implications from these studies. Because it is impossible to distinguish molybdenite from tungstenite by X-ray diffraction, all specimens reported here will be analyzed for W and Mo. — DBV

Mandarino, J. A. *See* Gait, R. I. 06640

Manheim, F. T. *See* Sayles, F. L. 06666

06820 **Manheim, F. T.** The diffusion of ions in unconsolidated sediments: Earth and Planetary Sci. Letters, v. 9, no. 4, p. 307-309, illus., table, 1970.

Diffusion in unconsolidated sediments generally proceeds at rates ranging from half to one twentieth of those applying to diffusion of ions and molecules in free solution. Diffusion rates are predictable with respect to porosity and path tortuosity in host sediments, and can be conveinently measured by determinations of electrical resistivity on bulk sediment samples. Net ion flux is further influenced by reactions of diffusing species with enclosing sediments, but such influences should not be confused with or lumped with diffusion processes. — Author's abstract

06635 **Manning, P. G.** Racah parameters and their relationship to lengths and covalencies of Mn^{2+}- and Fe^{3+}-oxygen bonds in silicates: Canadian Mineralogist, v. 10, pt. 4, p. 677-688, illus., tables, 1970.

The energies of the Russell-Saunders states ^4G and ^4D in Fe^{3+} and Mn^{2+} in a number of silicates have been determined from the identification of the field-independent transitions $^6A_1$ approaches $^4A_1{}^4E(G)$ and $^6A_1$ approaches $^4E(D)$. Adsorption bands marking these transitions are relatively sharp, which aids in their identification. The separations of the $^6S_1$, ^4G and ^4D levels are reduced in the bonded ions. Racah parameters have been calculated, and the *B*-parameters of Fe^{3+}, in particular, in three garnets, kyanite, vesuvianite and muscovite are discussed in terms of metal-oxygen covalency and, in turn, metal-oxygen distance. *B*-values are also reported for Fe^{3+} in tetrahedral sites in orthoclase. — Author's abstract

Marshall, Neil F. *See* Hanor, Jeffrey S. 07008

06603 **Marszalek, Donald Stanley.** Aspects of chamber formation by *Archias angulatus*, a foraminifer [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 761B, 1970.

Martens, H. H. *See* Whitnack, G. C. 00182

Martin, Richard H. *See* Donaldson, Alan C. 06748

Martinov, E. D. *See* Ryabinin, Yu. N. 00132

Masaki, Kazuaki. *See* Kumazawa, Mineo. 00123

06858 **Mason, Brian; Melson, William G.** The lunar rocks: New York, Wiley-Interscience, 179 p., illus., 1970.

Lunar mineralogy, limited to about 30 species, shows similarities to terrestrial basalts, and the presence of at least two new minerals; lunar petrology is essentially an igneous-rock petrology, with the addition of complex breccias evidently produced by impact; lunar geochemistry comprises the measurement of all chemical elements in the samples recovered by the Apollo teams. This book reviews the Apollo program, analyses of the data collected, and the application to problems of the origin and history of the Moon. — JHF

06732 **Matalucci, R. V.; Abdel-Hady, M.; Shelton, J. W.** Influence of microstructure of loess on triaxial shear strength: Eng. Geology, v. 4, no. 4, p. 341-351, illus., table, 1970.

Vicksburg loess is characterized by preferred orientation of grains, which on the average dip 4° N. 80-85° W. In this quantitative study of relations between its natural fabric anisotropies and orientation of applied stress distribution, results indicate that fabric anisotropies are reflected by definite variation in triaxial shear strength of dry and moist specimens. In two series of triaxial tests, its ultimate strength is maximum where σ_1 is perpendicular to grain orientation, and reduced where principal stresses are 45° to the fabric plane. The Mohr-Coulomb fracture line of two segments, with increase in slope at higher confining pressure, suggests that poorly-cemented sands, or sandstones, and silts, or siltstones, may undergo failure at small strains where cement bonds are disrupted, and at larger strains where internal shearing resistance of granular components is exceeded. — *from* Authors' abstract

Mathieu, Arthur. *See* Duquette, Gilles. 06757

06588 **Mathur, Jagdish Narain.** Analysis of the response of earth dams to earthquakes [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 669B, 1970.

Matz, David B. *See* Motts, Ward S. 06526

Maxwell, Ross A. *See* Brown, L. F., Jr. 07039

07108 **Maxwell, Ross A.** Introduction, physiography and geology, *in* Geologic and historic guide to the state parks of Texas: Texas Univ. Austin Bur. Econ. Geology Guidebook 10, p. 1-27, illus., tables, 1970.

The introduction to this report gives the history of the state parks of Texas. A brief description of the six physiographic subdivisions of the state includes the geologic background of each. The author also describes common rock types found in Texas and the general geologic history of the state. — EH

Mayou, Taylor V. *See* Frey, Robert W. 06983

06919 **McBirney, Alexander R.** Some current aspects of volcanology: Earth-Sci. Rev., v. 6, no. 5, p. 337-352, 1970.

Much recent work has been directed toward oceanic volcanism. The distribution, rates of eruption, and compositional variations of lavas with respect to large-scale features of the ocean floor seem to reflect major tectonic processes. The depths at which oceanic magmas are generated and acquire their chemical and mineralogical features is still difficult to estimate. Large numbers of volcanoes are associated with island arcs and the margins of continents next to trenches and active seismic zones. Volcanic activity in these places is episodic and may shift abruptly from one axis to another, generally seaward. The greatest volumes of continental volcanic rocks are found in flood basalts and siliceous ignimbrites. Techniques for predicting volcanic eruptions are still based almost entirely on empirical data rather than on a true understanding of the volcanic processes. — *from* Author's abstract

McCallum, I. S. *See* Drake, M. J. 06844

McCary, Charles E. L. *See* Barnes, Robert H. 07099

06687 **McClellan, William Alan.** Siluro-Devonian microfaunal biostratigraphy in Nevada [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 832B, 1970.

McGann-Lamar. *See* Lamar, D. L. 06543

06829 **McGlade, William G.** Environmental study of the Harrisburg area: Pennsylvania Geology, v. 1, no. 9, p. 2-5, illus., 1970.

The Pennsylvania Geological Survey has initiated an environmental study, scheduled for completion in late summer of 1971, of a heavily populated 325-sq mi area surrounding Harrisburg. In the four main parts of the study — basic geology, groundwater resources, mineral resources, and engineering geology — geologic data and principles will be interpreted, in application to the project area, for the use of planners, engineers, government officials, and the general public. — VMJ

McGuire, Robert C. *See* Tettenhorst, Rodney. 06502

06528 **McIntosh, Willard L.; Morgan, Ida M.** (compilers). Geologic map index of Ohio: Washington, D.C., U.S. Geol. Survey, scale 1:1,000,000, 1970.

06697 **McIntyre, Andrew; Bé, Allan W. H.; Roche, Michael B.** Modern Pacific Coccolithophorida — A paleontological thermometer: New York Acad. Sci. Trans., ser. 2, v. 32, no. 6, p. 720-731, illus., 1970.

Biogeographic distribution and ecological parameters are studied for 10 species of coccolithophorids (marine planktonic gold-brown algae) living in the Pacific Ocean; these species and their varieties delineate four water masses based on both single and overlapping species temperature ranges (optimum and maximum), constituting floral zones denoting temperature ranges of 0°-6°C, (subpolar-polar boundary), 6°-14°C, 14°-21°C, and above 21°C (tropical). These species occur also in Pleistocene sediments and some have already been used to show the migration of water bodies with late Pleistocene climatic fluctuations in the North Atlantic (McIntyre, 1967). With similar distributions established for the Pacific and Indian Oceans, a new paleontological thermometer is available for application to worldwide correlation and determination of mechanisms of glacial climatic changes. — VMJ

McKay, G. A. *See* Drake, M. J. 06844

00147 **McKenzie, Dan.** Comments on paper by John W. Minear and M. Nafi Toksöz, "Thermal regime of a downgoing slab and new global tectonics" (1970): Jour. Geophys. Research, v. 76, no. 2, p. 607-609, illus., 1971.

For original paper, *see* ibid., v. 75, no. 8, p. 1379-1419, 1970; Abs. North American Geology, August 1970.

McLean, W. John. *See* Williams, Sidney A. 06575

06895 **McLeroy, Donald F.** Genesis of Precambrian banded iron deposits, Rio Arriba County, New Mexico — A reply [to discussion by E. L. Beutner of 1970 paper]: Econ. Geology, v. 65, no. 8, p. 1008-1009, 1970.

For paper under discussion, *see* ibid., v. 65, no. 2, p. 195-205, 1970; Abs. North American Geology, March 1971. For discussion by McLeroy, *see* ibid., p. 1008.

06689 **McWilliams, Richebourg G., Jr.** Gravity survey of Marengo County, Alabama: Alabama Geol. Survey Circ. 59, 58 p., illus., tables, 1970.

During 1966 a gravity survey consisting of 1,054 gravity stations and covering an area of approximately 1,000 sq mi was made in Marengo County. Data reflect most known major geologic structures and indicate other features not evident from existing surface or subsurface geologic control, and should assist in interpreting the subsurface geology. Most significant gravity features are: the Thomasville gravity maximum, which reflects a basement high in southern Marengo County; a large area of low gravity values associated with a basement trough in the southeastern part; and an area of moderately high values indicating a low basement ridge in the eastern section. Low gravity values over part of the basement trough in the southeastern section may be influenced by Jurassic evaporite deposits. — *from* Author's abstract

06690 **McWilliams, Richebourg G., Jr.; Joiner, Thomas J.** Gravity survey of Baldwin County, Alabama: Alabama Geol. Survey Circ. 60, 84 p., illus., tables, 1970.

During 1967, a gravity survey consisting of 2,647 gravity stations and encompassing an area of approximately 1,600 sq mi was conducted in Baldwin County. Data reflected most of known major geologic structures and indicated other features not evident from existing surface and subsurface geologic control; newly indicated features should assist in interpreting the subsurface geology. The most significant gravity features are: small lineations near Tensaw that probably reflect faulting; three large areas of low gravity near Stockton, Stapleton, and between Robertsdale and Foley, interpreted to be broad, low-relief anticlinal structures, possibly with salt cores; and a large maximum near Bay Minette that probably reflects a basement high. The gravity gradient is low, which is typical of areas underlain by thick sediments containing salt deposits. — *from* Authors' abstract

Meidav, Tsvi. *See* Elders, Wilfred A. 06967

Melson, William G. *See* Mason, Brian. 06858

06542 **Merifield, P. M.; Lamar, D. L.** Paleotides and the geologic record, Chap. 5 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 31-40, illus., 1970.

This paper examines the features preserved in ancient sediments that are likely to provide information on paleotides, particularly as they relate to the Earth-Moon distance. Examination of late Precambrian and Lower Cambrian marine sediments of the southwestern United States and Lower Cambrian marine quartzites of Scotland reveals strong cross stratification reflecting high energy marine environments, most probably of strong tidal currents over large areas of continental shelves. It is not possible, however, to conclude that the Earth-Moon distance was considerably smaller than at present, since both occurrences could be explained by local conditions such as those found today in the Irish Sea and English Channel. Marine shelf deposits of similar ages should be studied on a worldwide basis for the presence of blanket cross-stratified quartzites. — VSN

Merifield, P. M. *See* Lamar, D. L. 06543

00166 **Merlino, Stafano; Sartori, Franco.** Ammonioborite — New borate polyion and its structure: Science, v. 171, no. 3969, p. 377-379, illus., tables, 1971.

The mineral ammonioborite is monoclinic with unit cell dimensions (in angstroms) - $a = 25.27$, $b = 9.65$, and $c = 11.56$; $\beta = 94°17'$, and the space group is C 2/c. Analysis of the crystal structure revealed the crystallo-chemical formula $(NH_4)_3B_{15}O_{20}(OH)_8.4H_2O$, with four such formula units in the unit cell. The basic structural unit is the double ring consisting of one BO_4 tetrahedron and four BO_3 triangles — in ammonioborite three of these units are connected to give trimeric ions $[B_{15}O_{20}(OH)_8]^{3-}$. — Authors' abstract

06589 **Mesri, Gholamreza.** Engineering properties of montmorillonite [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 670B, 1970.

Mesri, Gholamreza. *See* Olson, Roy E. 06775

06629 **Metherell, A. F.; Green, J.** Acoustical holography imaging of geological structures, *in* Laser applications in the geoscience (J. Gauger and F. F. Hall, Jr., editors) — Symposium, Huntington Beach, Calif., 1969, Proc.: North Hollywood, Calif., Western Periodicals Co., p. 267-279, illus., 1970.

Recent progress in the field of acoustical holography has demonstrated its feasibility as an effective imaging technique. This paper reviews the basic principles of acoustical holography and considers some of the problems of applying the methods to the visualization of geological structures. — Authors' abstract

06803 **México Con. Rec. Nat. no Renovables.** Mapa fotogeologico de la Sierra de Querétaro: Mexico, D.F., Mexico Consejo de Recursos Naturales no Renovables, scale 1:100,000, 1970.

Meyer, Charles, Jr. *See* Reid, Arch M. 06841

06874 **Meyer, Charles, Jr.** Sputter-condensation of silicates [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 251B-252B, 1970.

06738 **Meyerhof, G. G.** Safety factors in soil mechanics [with French abs.]: Canadian Geotech. Jour., v. 7, no. 4, p. 349-355, illus., 1970.

The influences on the safety margin in earthwork and foundation engineering are considered in relation to soil exploration and tests, analysis of stability under the applied loads, and construction and operation of the structure during its service life. Customary overall and suggested partial safety factors used in stability analyses are mainly governed by the variability and uncertainty of assessment of the soil resistance, the variability of applied loads, approximations in the stability analyses, and the seriousness of a failure. On the basis of probability concepts of safety, the conventional overall safety factors used in earthwork and foundation engineering analyses are related to approximate probabilities of stability failure and to a range of overall coefficients of variation, which are consistent with the range of observed coefficients of variation of the soil resistance, applied loads and stability analyses. — Author's abstract

06740 **Meyerhof, G. G.; Sebastyan, G. Y.** Settlement studies on air terminal building and apron, Vancouver International Airpost, British Columbia [with French abs.]: Canadian Geotech. Jour., v. 7, no. 4, p. 433-456, illus., tables, 1970.

The foundation conditions at the new Terminal Building and parking apron of the Vancouver International Airport are discussed, and settlements of the preload fills on the site are analyzed. The preconstruction estimates of the probable settlements of the foundations and apron are compared with the results of settlement observations during and after the construction of the terminal. The actual movements, which varied from about 1 in. (2.5 cm) to over 2 in. (5 cm) for the building and from about 2 in. (5 cm) to 5 in. (13 cm) for the apron, agree reasonably well with the predictions. — Authors' abstract

06936 **Meyers, J. Thomas.** Chert resources of the lower Illinois Valley: Illinois State Mus. Rept. Inv. 18 (Illinois Valley Archaeol. Program Research Papers, v. 2), 42 p., illus., tables, 1970.

This report discusses the distribution of chert raw material resources in the lower Illinois Valley region and its availability to prehistoric man. The first section describes procedures of sampling bedrock chert in a 5-mi radius of the Macoupin Site, a Havana-Hopewell habitation site, as well as the geology and geography of the area. The second section, which assesses chert availability in the valley, includes the physiography of the region, types of chert deposits and the geologic units in which they are found, and potential resources. — EH

Milici, Robert C. *See* Ferguson, Carl C. 07098

Miller, G. *See* Sokolowski, T. 06645

Miller, Gaylord. *See* Vitousek, Martin. 06752

06536 **Miller, Hugh.** Methods and results of river terracing, [Chap.] 1 *in* Rivers and river terraces (G. H. Dury, editor): London, Macmillan and Co. Ltd., p. 19-35, illus., condensed 1970; originally published 1883.

This paper is an essay toward elaboration of an outline-sketch produced by Playfair (1802), and was originally published in Royal Phys. Soc. Edinburgh Proc. VII. Hitchcock (1857) followed Playfair in recognizing that rivers will make terraces even if left alone, and divided terraces of the Connecticut River into four classes. Nine possible origins of terraces are listed. Methods of river terracing described are: formation of river curves, deflection pools; traveling of these features; planation; and relation between the traveling and formation of gravel. Terrace formation following Hitchcock's classification is discussed under three types of lateral terraces, fan or

lateral delta terraces, delta terraces, and gorge terraces. Sections on valleys viewed in relation to river terraces, and river terracing in miniature conclude the paper. — ESL

Miller, Roger L. *See* Reed, Bruce L. 00172

Minear, John W. *See* Toksoz, M. Nafi. 00117

00145 **Minear, John W.; Toksöz, M. Nafi.** Reply [to comments by Dan McKenzie on "Thermal regime of a downgoing slab and new global tectonics" (1970)]: Jour. Geophys. Research, v. 76, no. 2, p. 617-626, illus., tables, 1971.

For original paper, *see* ibid., v. 75, no. 8, p. 1397-1419, 1970; Abs. North American Geology, August 1970.

00193 **Minear, John W.; Toksöz, M. Nafi.** Reply to comments by Dan McKenzie on "Thermal regime of a downgoing slab and new global tectonics" (1970): Jour. Geophys. Research, v. 76, no. 2, p. 610-612, table, 1971.

For original paper, *see* ibid., v. 75, no. 8, p. 1397-1419, 1970; Abs. North American Geology, August 1970.

07051 **Mitchell, Richard S.** Virginia metamict minerals — X-ray diffraction study of samarskite: Southeastern Geology, v. 12, no. 2, p. 121-133, tables, 1970.

When heated in air at about 650°C metamict samarskite commonly crystallizes to form the samarskite phase, (Y, U, Fe) NbO_4, with $P2/c$, $a = 4.82$, $b = 5.63$, c 5.15 A, $\beta = 90°$ (cell from Komkov, 1965). Other phases which may develop, especially at higher temperatures, include hexagonal UNb_2O_8, monoclinic $YNbO_4$, monoclinic $FeNbO_4$, a tetragonal tapiolite-like phase, and an isometric betafite-like phase. Indexed X-ray powder data are given for each of these. Which phases form depends upon the specific composition of the specimen and the temperature of treatment. Samarskite is described from pegmatites in Amelia, Bedford, and Powhatan Counties, Virginia. — Author's abstract

00125 **Mogi, Kiyoo.** Fracture and flow of rocks under high triaxial compression: Jour. Geophys. Research, v. 76, no. 5, p. 1255-1269, illus., table, 1971.

The effects of the stress state on fracture and yielding of rocks were studied, using a new triaxial compression technique which allows study of the laws of fracture and flow of rocks under general triaxial stress states in which all three principal stresses are different. From the results it is inferred that yielding or fracture of an upper mantle region will occur when distortional strain energy stored there reaches a critical value which increases with effective mean pressure on slip planes, and that in deep regions the possibility of fracture occurrence (earthquakes) is higher than expected from conventional triaxial compression experiments because high values of intermediate compression cause a decrease in ductility. — DBV

Monnin, M. *See* Burnett, D. S. 06846

06582 **Mooney, Harold M.; Craddock, Campbell; Farnham, Paul R.; Johnson, Stephen H.; Volz, Gary.** Refraction seismic investigations of the northern Midcontinent Gravity High [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 28-29, 1970.

Mooney, Harold M. *See* Craddock, Campbell. 06938

06788 **Moore, James G.** Water content of basalt erupted on the ocean floor: Contr. Mineralogy and Petrology, v. 28, no. 4, p. 272-279, illus., table, 1970.

Vesicularity in pillow basalts changes with composition and depth, and alkalic basalts are more vesicular than tholeiitic. Experimentally determined data show the K-poor basalts originally contained 0.25 percent water, Hawaiian tholeiites about 0.5 per-

cent, and alkali-rich basalts about 0.9 percent water. Fresh basalt pillows show a systematic increase of H_2O^+ as rocks become more alkalic. K-poor tholeiites have 0.06-0.42 percent H_2O^+, Hawaiian tholeiites 0.31-0.60 percent H_2O^+, and alkali-rich basalts 0.49-0.98 percent H_2O^+. K_2O, P_2O_5, F, and Cl^- increase with an increase in H_2O^+, and it can be shown that no appreciable sea water was absorbed by the pillow during or subsequent to eruption on the ocean floor. Concentrations of volatile constituents in alkali basalt melts relative to tholeiitic melts can be explained by varying degrees of partial melting of mantle material or by fractional crystallization of a magma batch. — *from* Author's abstract

06604 **Moore, Raymond Kenworthy.** Spectroscopic properties of the natural silicate garnets [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 761B, 1970.

Moore, Samuel L. *See* Peterson, Warren L. 00161

06875 **Moran, Stephen Royse.** Geology of the Hudson Bay area, Saskatchewan [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 252B, 1970.

Morgan, Ida M. *See* McIntosh, Willard L. 06528

06847 **Morgan, J. W.; Ehmann, W. D.** Lunar rock 12013 — O, Si, Al, and Fe abundances: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 164-168, illus., table, 1970.

The abundances of O, Si, Al, and Fe have been determined by 14 MeV neutron activation analysis in 5 chips and 3 powders derived from Apollo 12 lunar rock 12013. These 4 elements constitute approximately 90 percent of the mass of this rock. Mass weighted mean abundances in weight percent for the 5 chips where contamination problems are expected to be minimal are: O: 45.2; Si: 28.4; Al: 6.5; Fe: 10. A significant positive correlation was observed for Si and O abundances in the chips, and the linear regression line drawn through these data passes close to the mean for the Apollo 11 breccias. A significant negative correlation was observed for Al with Si in the chips. — Authors' abstract

06705 **Morgan, James P.; Shaver, Robert H.** (editors). Deltaic sedimentation, modern and ancient: Soc. Econ. Paleontologists and Mineralogists Spec. Pub. 15, 312 p., illus., tables, 1970.

The papers in this volume are based in part on a symposium on deltaic sedimentation sponsored by the Society of Economic Paleontologists and Mineralogists in New Orleans, La., on April 26, 1965. Papers by Allen, Wanless and others, and Weimer were given at the symposium, but have been considerably modified since their original presentation. Of the 14 papers included in the volume, 10 are cited separately. — VSN

06749 **Morgan, James P.** Depositional processes and products in the deltaic environment, *in* Deltaic sedimentation, modern and ancient: Soc. Econ. Paleontologists and Mineralogists Spec. Pub. 15, p. 31-47, illus., tables, 1970.

Factors controlling depositional processes and products are analyzed for three major river-delta systems: the Mississippi, Ganges-Brahmaputra, and Mekong. These deltas display varied geomorphic form which reflects differences in depositional process and products of interest in determining ancient deltaic environments. Four basic factors control and influence delta formation: river regime; coastal processes; structural behavior (relation of sea level to depositional site); and climatic factors, particularly those affecting vegetation within the delta. The Mississippi delta area is characterized by rapid subsidence, primarily through sediment compaction, and its deposits are subject only to minor modification by coastal processes. Several overlapping deltas have formed with systematic lateral shifting during progradation. Lenticular channel file and beach sands are present but no extensive laterally continuous sand bodies. — *from* Author's abstract

07071 **Morris, Gerald B.** Picking first energy on marine seismic refraction records: Deep-Sea Research, v. 17, no. 5, p. 913-915, illus., 1970.

From marine seismic refraction records an empirical relation is determined between the explosive charge weight and the onset time which is defined as the time interval from the first arriving seismic energy and the first downswing or minimum pressure. Different explosive compounds, TNT, Composition B, and Nitramon all appear to follow the relation: Onset time (sec) = 0.086 + 0.015 log weight (kg). — Author's abstract

Morrison, Ross A. *See* Lee, Kenneth L. 06777

07044 **Mosteller, Moice A.** Subsurface stratigraphy of the Comanchean Series in east central Texas: Baylor Geol. Studies Bull. 19, 33 p., illus., 1970.

The Comanchean Series is a thick wedge of deltaic clastics and shallow marine limestones and shales which fill the East Texas basin and lap westward onto the Texas craton. The Travis Peak Formation was deposited by deltaic processes, then the Glen Rose shales were deposited in a shallow lagoon, southeast of which the Stuart City reef separated lagoon from back reef province. The Ferry Lake anhydrite was then precipitated in the lagoon. Regression occurred during deposition of the Fredericksburg Group, while rudistid reefs, the Edwards Formation formed north and west of the Stuart City trend. Washita transgression covered the entire area, after which the area was uplifted and tilted to the southeast. Doming and thick stratigraphic sections occur in the areas of salt withdrawal. The Mexia fault movement was contemporaneous with deposition. A hinge line trended across eastern Hill and McLennan counties. — HRC

06519 **Motts, Ward S.** Introduction to playa studies, Chap. 1 *in* Geology and hydrology of selected playas in western United States (Ward S. Motts, editor) — Univ. Massachusetts, Geology Dept., Contract AF19(628)-2486, Final Sci. Rept., Pt. 2: Bedford, Mass., U.S. Air Force Office Aerospace Research, p. 1-22, illus., table, 1970.

This introductory chapter describes the purposes, methods, and area of the investigation, reviews previous investigations, defines the term playa, describes the geomorphic and hydrologic setting of playas, and locates the playa complex studied. — DBV

06520 **Motts, Ward S.; Carpenter, David.** Geology and hydrology of Rogers Playa and Rosamond Playa, California, Chap. 2 *in* Geology and hydrology of selected playas in western United States (Ward S. Motts, editor) — Univ. Massachusetts, Geology Dept., Contract AF19(628)-2486, Final Sci. Rept., Pt. 2: Bedford, Mass., U.S. Air Force Office Aerospace Research, p. 23-65, illus., 1970.

In 1964-68, five major playa-surface types were observed on Rogers and Rosamond Playas in the Mojave Desert. They varied from year to year primarily because of surface-water floodings, accompanied by deposition of a thin layer of sediment which upon drying formed mud curls subject to wind deflation. Fine-grained silt and clay form a relatively thin blanket resting on a much thicker deposit of sand and gravel. Water under hydrostatic pressure was encountered in test holes penetrating the sand and gravels. There is a general downward increase in moisture content of fine-grained sediments of the same size, a decrease with increasing grain size, and a decrease in some clays and silts overlying sand zones. Dessication of fine-grained deposits, accompanied by lowering of potentiometric levels, has been an important factor in formation of giant dessication polygons on Rogers Playa. There is less capillarity and gravity drainage at Rosamond Playa. — DBV

06522 **Motts, Ward S.** Results of test-drilling and winter mapping programs on Coyote Playa, California, Chap. 3, Pt. 2 *in* Geology and hydrology of selected playas in western United States (Ward S. Motts, editor) — Univ. Massachusetts, Geology Dept., Contract AF19(628)-2486, Final Sci. Rept., Pt. 2: Bedford, Mass., U.S. Air Force Office Aerospace Research, p. 108-136, illus., 1970.

In order to learn more about the sediments and geomorphic processes operative on Coyote Playa, a rotary drilling and coring program was conducted in 1965-66 as part of a broader drilling program on Mojave playas. Data from the drilling program and

field work suggest the playa has a large interconnected zone of shallow subsurface permeability, 10–25 feet deep, which may be more extensive than the surface expression of giant dessication polygons; ground water is discharging through the surface by capillarity from this shallow system and by capillarity combined with hydrostatic head from a deeper artesian aquifer; and some surface features, including puffy ground and the wavy undulating surface, may be formed wholly or partly from processes associated with ground-water discharge. Recharge of the shallow permeable zone occurs primarily during floodings. The deeper artesian zone is recharged through alluvial fans and ephemeral streams. — DBV

Motts, Ward S. *See* Walker, Robert F. 06523

06525 **Motts, Ward S.** Geology of Troy Playa surface, winter of 1967-68, *in* Geology and hydrology of selected playas in western United States (Ward S. Motts, editor) — Univ. Massachusetts, Geology Dept., Contract AF19(628)-2486, Final Sci. Rept., Pt. 2: Bedford, Mass., U.S. Air Force Office Aerospace Research, p. 200-202, illus., 1970.

Remapping of the surface of Troy Playa in January and February of 1968 showed that the morphology of the playa surface had changed considerably since it was mapped in 1963 and 1964. The hard-compacted, mud-cracked surface was more extensive throughout the northern part. This change could be related to heavy flooding in November and December 1967, but could also result in part from long-term changes. Other differences included a smooth hard surface underlain by white calcareous and evaporite material not present in 1963, xerophytes and xerophyte mounds encroaching onto the eastern edge, and the death and decay of some of the vegetation mounds in the southeastern part. — DBV

06526 **Motts, Ward S.; Matz, David B.** Reconnaissance geology of Clayton Playa, Nevada, Chap. 6 *in* Geology and hydrology of selected playas in western United States (Ward S. Motts, editor) — Univ. Massachusetts, Geology Dept., Contract AF19(628)-2486, Final Sci. Rept., Pt. 2: Bedford, Mass., U.S. Air Force Office Aerospace Research, p. 214-236, illus., 1970.

Clayton Playa, typical of groundwater-discharging playas, is characterized by a diversity of geomorphic types: a plant-mound zone; a channeled-puffy zone; a travertine crust zone; a calcareous-subsurface zone; a travertine-butte zone; a central-playa zone (wet smooth surface); irregular knobby areas (caused by encrustation of salt and deposition of silt and mud around accumulations of flood-carried debris); and a mine tailings zone. These last, well stratified outside the playa boundary, become disrupted, soft, and puffy within the playa where capillary discharge occurs. — DBV

06527 **Motts, Ward S.** Some hydrologic and geologic processes influencing playa development in the western part of the Basin and Range Province, United States, Chap. 7 *in* Geology and hydrology of selected playas in western United States (Ward S. Motts, editor) — Univ. Massachusetts, Geology Dept., Contract AF19(628)-2486, Final Sci. Rept., Pt. 2: Bedford, Mass., U.S. Air Force Office Aerospace Research, p. 237-286, illus., tables, 1970.

Surface morphology of most coarse-grained and many fine-grained playas is related to several factors. Puffy ground is formed when capillary discharge is rapid and flooding infrequent; a smooth surface is formed when capillary discharge is slow and floodings relatively frequent. Many Mojave playas are flooded during the winter; their surface morphology is then affected by wind-produced shifting of water on the playa, saturation of near-surface silts and clays which increases their mobility, and disruption and destruction of the surface by ice, which further promotes wind erosion. Geomorphic features of playas constantly change in response to short- and long-term climatic fluctuations. Many playas have considerably increased in size in Recent time. Sediments deposited in Mojave Desert playas are soon removed by wind erosion. — DBV

06578 **Motts, Ward S.** (editor). Geology and hydrology of selected playas in western United States — Univ. Massachusetts, Geology Dept., Contract AF19(628)-2486,

Final Sci. Rept., Pt. 2: Bedford, Mass., U.S. Air Force Office Aerospace Research (AFCRL-69c0214), 286 p., illus., tables, 1970.

The playas studied during the investigation reported in this volume may be divided into fine-grained (characterized by medium silt-through fine clay sized deposits; slow artesian and capillary movement of water through the surface; mostly smooth, hard surfaces; and current formation of giant dessication polygons in many) and coarse-grained (characterized by deposits of sand, silt, and sometimes evaporites; rapid capillary discharge; water table nearly coinciding with the playa surface; and soft surficial sediments). The surface morphology of most is related to several factors including rate of capillary discharge and frequency of surface-water flooding. Playas are dynamic landforms that change over years because of long-term climatic and environmental changes, or over days or months because of short-term climatic effects. A long-term change has been recent expansion of many playas. — DBV

06792 **Moxham, R. M.** Thermal features at volcanoes in the Cascade Range, as observed by aerial infrared surveys: Bull. Volcanol., v. 34, no. 1, p. 77-106, illus., table, 1970.

There have been no substantial changes in the thermal patterns at the summit of Mount Rainier in the period September 1964-1966. An anomaly was recorded by both surveys at a snow-free area on the west flank of the summit cone, several hundred feet below the west crater ruin. Other anomalous thermal zones at the summit are on the northern quadrants of both crater rims. A small fumarole on Mount Adams was not detected. An anomaly on Mount St. Helens corresponds to a known fumarole area. The only thermal feature on Mount Shasta corresponds to a known thermal spring near the summit. Two anomalies were found on the north flank of Lassen Peak where no thermal activity has been reported; much of the other thermal activity in this area is in the northeast quadrant of Brokeoff Caldera, for the most part corresponding to well documented features. — DBV

06825 **Mueller, Paul A.** TiO_2 and K-Ar age — A covariation in the mafic rocks of the southern Beartooth Mountains of Montana and Wyoming: Earth and Planetary Sci. Letters, v. 9, no. 5, p. 427-430, illus., 1970.

K-Ar whole rock ages and TiO_2 contents of 26 mafic rocks of the southern Beartooth Mountains indicate a negative correlation between age and TiO_2. This variation spans 1900 m.y. and may indicate a diminishing contribution of basaltic material to the continent through time. — Author's abstract

06794 **Mueller, Robert F.; Ghose, Subrata; Saxena, Surendra K.** Partitioning of cations between coexisting single- and multi-site phases — A discussion [of paper by J. E. Grover and P. M. Orville, 1969]: Geochim. et Cosmochim. Acta, v. 34, no. 12, p. 1356-1360, 1970.

This is a discussion of a paper by Grover and Orville (ibid., v. 33, no. 2, p. 205-226, 1969; *see* Abs. North American Geology, July 1969.

06486 **Mulder, David C.** Ore controls and open pit geological procedures at Steep Rock Iron Mines Limited [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 30, 1970.

00171 **Mullens, Thomas E.** Reconnaissance study of the Wasatch, Evanston, and Echo Canyon Formations in part of northern Utah: U.S. Geol. Survey Bull. 1311-D, p. D1-D31, illus., table, geol. map, 1971.

Upper Cretaceous and lower Tertiary orogenic conglomerates in part of northern Utah can be divided into three formations. The Echo Canyon Conglomerate, 0-3100 feet thick and of Late Cretaceous age is at the base. The overlying Evanston Formation is 0-1400 feet thick and has two parts, a basal conglomerate of Late Cretaceous age and an upper unit of Late Cretaceous and Paleocene age. The Wasatch Formation is as much as 5,000 feet thick and is of Paleocene and Eocene age. The formations are mainly reddish-brown conglomerate composed of quartzite, sandstone, silt-

stone, and limestone clasts interbedded with reddish-brown conglomeratic sandstone and mudstone, but the upper part of the Evanston is mainly gray grit and silty sandstone. The Wasatch Formation grades eastward to a finer grained facies. — TEM

Murata, K. J. *See* Richter, D. H. 06692

06650 **Murphy, L. M.; Eppley, R. A.** Developments and plans for the Pacific Tsunami Warning System, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 261-270, illus., 1970.

The Pacific Tsunami Warning System is continuing to expand in both the number of participants and the scope of warning responsibility. Plans are now underway for addition of six new seismic and eight new tide stations to the Warning System. New visible recording seismic systems and electronic recording tide gauges are being supplied to many participating stations. Earlier warnings to residents of Hawaii for locally generated tsunamis is the objective of the Experimental Tsunami Warning System in Hawaii, now being installed by the University of Hawaii under an Environmental Science Services Administration (ESSA) contract. Several recent tsunami operations of the Alaska Regional Warning System are described as well as a new research study to determine the effectiveness of the Alaska Warning System. — Authors' abstract

Murphy, William J. *See* Fischer, Joseph A. 06977

Murray, B. *See* Rex, R. W. 06730

Murray, E. J. *See* Harris, D. C. 06753

Murray, James W. *See* Birkhead, Paul K. 06758

06646 **Murty, T. S.; Bollard, Lise.** The tsunami in Alberni Inlet caused by the Alaska earthquake of March 1964, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 165-187, illus., tables, 1970.

The tsunami in Alberni Inlet due to the Alaska earthquake of March, 1964, is studied theoretically. Some preliminary results are presented here. To evaluate the role of local resonance, the frequencies of natural oscillation of the Alberni Inlet and Trevor Channel have been calculated taking the topography into account. The propagation of the tsunami into the inlet has been calculated as an initial-value problem. Power spectral analyses of several tide-gauge records on the west coast of Canada during this period have been made to determine the energy contained in various frequency ranges. A new technique known as cepstrum analysis, originally developed by Tukey and colleagues, has also been attempted to isolate the influence of reflections of the trapped energy of the tsunami inside the inlet. — Authors' abstract

06742 **Nagata, Takesi.** Palaeomagnetic data in connection with the evolution of the Earth's core, *in* Geophysical studies on the evolution of the Earth's deep interior — A symposium, Madrid, 1969, Proc.: Physics Earth and Planetary Interiors, v. 2, no. 5 (spec. issue), p. 311-317, illus., 1970.

Geomagnetic intensity throughout geologic time has been fluctuating around the present value. This may indicate that the size and physical conditions of the Earth's core have been approximately the same in the past as at present. Geomagnetic field polarity has been repeatedly reversed. During the latest 10 m.y., the average time length of the polarity interval is about 0.21×10^6 yr. If we assume that the asymmetrically distorted convection motion within the Earth's core has a symmetric pattern with time intervals of 0.105×10^6 yr on average, the observed histogram of polarity intervals can be explained. This is because the Bullard-Gellman dynamo convection motion is unstable, whereas the Bullard-Gellman-Lilley dynamo becomes steady to result in a stationary dipole field of either northward or southward polarity. — *from* Author's abstract

06553 **Nargolwalla, S. S.; Niewodniczanski, J.; Sudduth, J. E.** Experimental sensitivities for 3 MeV neutron activation analysis: Jour. Radioanal. Chemistry, v. 5, no. 2, p. 403-423, illus., tables, 1970.

The experimental sensitivity for 72 different elements using 3MeV neutron activation has been investigated. Using a 200 kV Cockcroft-Walton neutron generator with a 3 MeV neutron flux of about 1.5×10^8 n cm^2 sec^{-1}, γ-ray spectra of 51 elements were obtained with a sufficient number of photopeak counts for sensitivity calculations using a photopeak integration method. A useful table summarizing the sensitivity results is given. That 3 MeV neutron activation analysis is practical, is demonstrated by the experimental sensitivities obtained. — Authors' abstract

Nelson, R. E. *See* Nettleton, W. D. 07063

07063 **Nettleton, W. D.; Flach, K. W.; Nelson, R. E.** Pedogenic weathering of tonalite in southern California: Geoderma, v. 4, no. 4, p. 387-402, illus., tables, 1970.

The tonalite (quartz diorite) has weathered under a mediterranean climate to depths of more than 30 m; expansion of biotite as it weathered to vermiculite broke up the rock. Weathering was studied in three kinds of environments in four associated soils in a toposequence. Differences in environments are results of differences in topographic positions. A slightly leached environment occurs on hilltops and backslopes where vermiculite and kaolinite form from biotite. A high sodium environment occurs in footslope positions, where biotite weathers to vermiculite and kaolinite, andesine and hornblende to montmorillonite. A base-rich environment is found in areas of subdued relief and restricted drainage; biotite weathers to vermiculite and montmorillonite, andesine and hornblende to beidellite-montmorillonite. The stability sequence of primary minerals from least to most stable is biotite, andesine, hornblende, and quartz. — *from* Authors' abstract

06827 **Newell, Wayne L.** Factors influencing the grain of the topography along the Willoughby Arch in northeastern Vermont: Geog. Annaler, v. 52A, no. 2, p. 103-112, illus., 1970.

Equal-area plots of maximum slope linears from each of three study areas along the Willoughby Arch in northeastern Vermont are analyzed and compared with the bedrock joint system and evidence of glacial ice movement within the respective areas. These analyses reveal a correspondence of the topographic fabric to the bedrock fracture pattern and a supplementary relationship between the movement of glacial ice and the topography. This information indicates that the topography adjusted to the orientation of bedrock fractures before the Pleistocene. Chemical erosion is suggested as the major process effecting this relationship. The fracture-pattern-oriented topography prevails today with only slight modification by glaciation. This is confirmed by the linear data on the direction of glacial ice flow and the areal distribution of Pleistocene deposits on the three areas. — Author's abstract

Newton, George D. *See* Lundin, Robert F. 06566

Nicholls, J. *See* Ghent, E. D. 06786

07055 **Nichols, R. A. H.** Petrology and economic geology of the Upper Devonian Birdbear Formation in southeastern Saskatchewan: Saskatchewan Dept. Mineral Resources Rept. 125, 94 p., illus., tables, 1970.

Fossils indicate a Frasnian age for the lower carbonate unit of the Birdbear Formation which was deposited in a restricted shallow marine shelf environment. During deposition of the upper anhydrite-carbonate unit repeated uplift, regression and arid climatic conditions favored accumulation of sulfate and carbonate sediments and restricted animal and plant life. Large parts of Middle Devonian Prairie Evaporite salt beds were dissolved. "Early" solutioning caused deposition of thick sections of the Upper Devonian Duperow Formation and local "highs" over them were formed when "later" solutioning caused subsidence of surrounding beds. Oil and gas are found on the flanks of some structures. Dolomite and dolomitic limestone of the

upper part of the carbonate unit contain the most porous zone which is capped by anhydrite. Prospective locations for oil and gas accumulations are west of Weyburn, west of Hummingbird and isolated localities in the eastern part of the area. — *from* Author's abstract

Nickel, E. H. *See* Faye, G. H. 06631

Niewodniczanski, J. *See* Nargolwalla, S. S. 06553

Nitecki, Matthew H. *See* Golden, Julia. 06898

Nitecki, Matthew H. *See* Golden, Julia. 06899

Nitecki, Matthew H. *See* Golden, Julia. 06900

06901 **Nitecki, Matthew H.** Redescription of *Ischadites elrodi* (S. A. Miller, 1892), a Lower Devonian receptaculitid: Fieldiana — Geology, v. 20, no. 5, p. 77-83, illus., 1970.

Miller's original description of this species as *Receptaculites elrodi* (family Receptaculitidae, class Porifera) was based on a single specimen from the lower Middle Devonian (probably Geneva Dolomite) near Hartsville, Ind. The holotype and only specimen is here redescribed as a dasycladaceous alga closely related to the Silurian *Ischadites koenigii* Murchison, 1839 (redescribed by Nitecki, 1969). The missing portion of the lower end of the pyriform thallus is reconstructed as an elongate stalk. — VMJ

06816 **Normark, W. R.** Channel piracy on Monterey Deep-Sea Fan: Deep-Sea Research, v. 17, no. 5, p. 837-846, illus., table, 1970.

The present Monterey Fan-Valley extends 300 km across the Monterey Deep-Sea Fan with a 400 m relief on the upper fan where large levees border the western bank. Seismic reflection profiling on the upper fan suggests that extensive erosion within Monterey Fan-Valley increased its relief by at least 200 m after it had taken over the lower end of the parallel Ascension Fan-Valley. At present, the latter enters the Monterey Fan-Valley as a hanging valley. A beheaded, leveed valley, the Monterey East Fan-Valley, marks the old course of the Monterey Fan-Valley. — Author's abstract

Northern California Geological Society. *See* U.S. Geological Survey. 07074

06512 **Norton, James J.** Composition of a pegmatite, Keystone, South Dakota: Am. Mineralogist, v. 55, nos. 5-6, p. 981-1002, illus., tables, 1970.

A geologically simple pegmatite near Keystone, South Dakota, contains 33.6 percent albite, 30.4 percent quartz, 21.0 percent perthite, 14.0 percent muscovite, and 1.0 percent accessory minerals. Bulk chemical composition is given. The perthite content exceeds 30 percent near the hanging wall and gradually diminishes to less than 10 percent near the footwall. This decrease is offset mainly by an increase in albite; quartz and muscovite are more uniform in abundance. — *from* Author's abstract

Norton, S. A. *See* Hatch, Norman L., Jr. 06695

Norton, Stephen A. *See* Osberg, Philip H. 00189

00126 **Nur, Amos.** Viscous phase in rocks and the low-velocity zone: Jour. Geophys. Research, v. 76, no. 5, p. 1270-1277, illus., 1971.

Partial melt in the low-velocity zone (LVZ) explains basaltic volcanism and serves as a soft layer for plate tectonics. If the melt occurs in inclusions, effective bulk modulus depends mainly on bulk modulus of the inclusions and their aspect ratio. Effective shear modulus and attenuation in shear depend on viscosity, aspect ratio, and frequency of applied stress waves. A very small amount of melt in narrow inclusions

can cause a large reduction in shear modulus. Both effective shear modulus and attenuation in shear depend on viscosity and frequency; thus, if there is partial melt in the LVZ, velocity and attenuation in that zone and its shape are frequency-dependent. When short-period and long-period seismic velocity data are combined, the ratio of relaxed to unrelaxed shear moduli in the LVZ is about 0.83, the viscosity of the melt in the LVZ is about 10^7 poises, and the period at which attenuation in shear has a peak is around 20 sec. — *from* Author's abstract

Nyquist, L. E. *See* Begemann, F. 06821

06552 **O'Brien, Charles F.** *Eozoon Canadense*, "the dawn animal of Canada": Isis, v. 61, pt. 2, no. 207, p. 206-223, 1970.

The "dawn animal" was first found in Precambrian metamorphosed limestones of eastern Canada in 1858 and was described by J. W. Dawson (1865) as a gigantic nummulite-like foraminifer. The controversy over the organic versus inorganic nature of the "fossil" lasted for nearly 50 years, during which time other specimens were found, and involved first Canadian and British, then American and continental European scientists; in 1891, J. W. Gregory demonstrated that the laminated calcite-serpentine structure was inorganic and mechanically developed by great heat and pressure on limestone. The controversy, here chronicled, is significant in the history of science as an example of how every aspect of nineteenth-century paleontology was scrutinized for its bearing on evolution, and of the confrontation of younger specialists with each other and with the older generation of broadly trained "naturalists." — VMJ

06835 **Ogren, D. E.** Ostracoda from the Paleocene Clayton Formation in central Georgia: Georgia Acad. Sci. Bull., v. 28, no. 4, p. 149-152, illus., 1970.

Seventeen species in seventeen genera of ostracodes from the Clayton formation in Macon County are described and illustrated. The lithology, resembling that of the type section in Alabama and containing large oyster remains, represents deposition in shallow water and may have been deposited near shore. — HRC

06487 **Oja, R.** Keweenawan copper deposits in the Archean of northwestern Ontario [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 31, 1970.

06488 **Ojakangas, Richard W.** Geology of a greenstone belt in Minnesota — Rainy Lake to Lake of the Woods [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 32-33, 1970.

06876 **Okulitch, Andrew Vladimir.** Geology of Mount Kobau [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 252B-253B, 1970.

06744 **Oliver, Jack.** Structure and evolution of the mobile seismic belts, *in* Geophysical studies on the evolution of the Earth's deep interior — A symposium, Madrid, 1969, Proc.: Physics Earth and Planetary Interiors, v. 2, no. 5 (spec. issue), p. 350-362, illus., 1970.

Mobile seismic belts of the Earth, a worldwide phenomenon, are discussed in light of the modern theory of plate tectonics. The mobile belts are at the boundaries of these lithosphere plates. The discussion is illustrated by examination of 'typical' modern island arcs — the Tonga-Fiji region, Mariana arc, Izu-Bonin arc, the Aleutians, and West Indies. Yeats' model of the California island arc of Jurassic-Cretaceous and Dewey's model of the British Caledonides are cited as ancient examples of plate tectonics. — VSN

06559 **Ollerhead, R. W.; Alexander, T. K.; Hausser, O.** Lifetimes in S-32: Canadian Jour. Physics, v. 48, no. 1, p. 47-55, illus., tables, 1970.

Lifetimes have been measured for five levels in S-32. Levels were populated by inelastic scattering of protons, and gamma-rays detected at angles between 0° and 127° using a 40 cm^3 Ge(Li) detector inside a split annular NaI crystal. The spectrometer was used simultaneously as an escape-suppressed and a three-crystal pair spectrometer. Decay schemes and lifetimes have been determined using thick targets of sulfides and sulfur cooled to 77°K. Lieftime information was obtained from analysis of gamma-ray line shapes and of Doppler shift attenuation. The two methods agree within the errors, and gave an average lifetime of $7.5 \pm 0.5 \times 10^{-13}$s. A similar analysis gave a lifetime of $4.9 \pm 0.9 \times 10^{-13}$s. Other lifetimes for other levels are given, and transition strengths are tabulated and discussed. — *from* Authors' abstract

06576 **Olsen, Edward; Bunch, T. E.** Compositions of natural osumilites: Am. Mineralogist, v. 55, nos. 5-6, p. 875-879, illus., tables, 1970.

Osumilite from the type locality, Sakkabira, Japan, has been analyzed by electron microprobe and major differences are observed contrasted with the original wet-chemical analysis. The other two known world occurrences, Sardinia and Oregon, were analyzed. Comparison of all three shows a variation in the number of Na ions per formula accompanied by variations in the percentage of vacancies in the alkali position. Because of the analytical totals no constituent water can be inferred in these osumilites. One occurrence (Oregon) exhibits a paragenesis which offers the first field evidence of the type of breakdown of (metastable) osumilite observed in laboratory experiments. — Authors' abstract

06775 **Olson, Roy E.; Mesri, Gholamreza.** Mechanisms controlling compressibility of clays: Am. Soc. Civil Engineers Proc., v. 96, paper 7649, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 1863-1878, illus., tables, 1970.

The consolidation characteristics of clays are controlled by mechanical and physico-chemical effects. Although these effects operate simultaneously one-dimensional consolidation tests indicate that one or the other usually dominates. The consolidation characteristics of sands, mica, and kaolinites are mechanically controlled whereas those of smectite are physico-chemically controlled. Illite occupies an intermediate position in that the virgin compression curve seems to be controlled by mechanical variables, whereas the swelling curve is influenced by both effects; the physico-chemical effect is more important when the adsorbed cations are monovalent and the pore water electrolyte concentration is low. — ASCE abstract

Opdyke, N. D. *See* Henry, K. W. 06669

06782 **Orchard, R. J.; Knecht, Joseph; Voytko, George A.** State of predictive art in subsidence engineering — Discussion [of paper 7187 by Barry Voight and William Pariseau, 1970]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 2162-2163, 1970.

Paper 7187 was published ibid., v. 96, no. SM 2, p. 721-750, 1970; *see* Abs. North American Geology, January 1971.

Orlopp, Donald R. *See* Wanless, H. R. 06708

07084 **Orth, Donald J.** North Slope geographic name sources for geologic nomenclature, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. R1-R10, 1970.

An alphabetical list is given of all geographic names on the North Slope of Alaska that form the source for existing and abandoned geologic names listed in the preceding paper (Kopf, p. Q1-Q5). Each entry consists of two paragraphs: the first gives its application and location, and lists variant forms; the second gives the history and meaning of the name and the geologic name for which it is the source with author and name and date when first published. A pronunciation guide is included for Eskimo names. — VSN

Orville, Philip M. *See* Grover, John E. 06795

00189 **Osberg, Philip H.; Hatch, Norman L., Jr.; Norton, Stephen A.** Geologic map of the Plainfield quadrangle, Franklin, Hampshire and Berkshire Counties, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-877, scale 1:24,000, sections, text, 1971.

Metamorphosed sedimentary and volcanic rocks in the Plainfield quadrangle are: Cambrian-Ordovician Rowe Schist, Ordovician Moretown and Hawley Formations, and Silurian-Devonian Goshen Formation. Intrusive igneous rocks are talc-carbonate schist, gneiss, and metamorphosed mafic dikes. Metamorphic rocks are in the east limb of the Berkshire anticlinorium; patterns of structural features are complex and represent superposition of several episodes of deformation. Possible economic resources consist of a body of talc-ferroan magnesite rock; an ore body containing pyrite, chalcopyrite, and sphalerite; magnetite-hematite-spessartite prospects; spessartite-rhodonite-rhodochrosite prospects; and deposits of sand and gravel. — MCM

06828 **Östrem, G.; Arnold, K.** Ice-cored moraines in southern British Columbia and Alberta, Canada: Geog. Annaler, v. 52A, no. 2, p. 120-128, illus., 1970.

Based upon experience from air photo interpretation in Scandinavia where ice-cored moraines were identified in the pictures, a similar survey was carried out for an area in southern British Columbia and Alberta. The distribution of various types of end moraine ridges was determined from medium and high-altitude photographs and the results plotted on a map on the scale of 1:2,000,000. On the same map the glacier distribution was transferred from the Canadian glacier map (Falconer et al., 1966). The height of the glaciation limit (Östrem 1966b) was also indicated on the map by contour lines. The result of this investigation indicates that the proportion of ice-cored end moraines increases from the coast inland. The highest ratio of ice-cored end moraines is found in areas where the glaciation limit reaches its highest altitudes. These areas generally have the most continental climate, and permafrost will be found above certain elevations. — Authors' abstract

00162 **Outerbridge, William F.** Geologic map of the Brooksville quadrangle, Bracken County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-905, scale 1:24,000, text, 1971.

The chief mineral resource in the Brooksville quadrangle is limestone now quarried from the Middle Ordovician High Bridge Group for road material. Ground water is hard in all sections. The Point Pleasant and lower part of the Fairview Formations stand well in steep-walled cuts and have stable slopes; the Kope and upper part of the Fairview do not. — MCM

07088 **Overbey, W. K., Jr.; Henniger, B. R.** Disaggregation of sandstones by ultrasonic energy [abs.]: West Virginia Acad. Sci. Proc. 1969, v. 41 (West Virginia Univ. Bull., ser. 70, no. 11-3), p. 193, 1970.

00128 **Oxburgh, E. R.; Turcotte, D. L.** Origin of paired metamorphic belts and crustal dilation in island arc regions: Jour. Geophys. Research, v. 76, no. 5, p. 1315-1327, illus., 1971.

Quantitative plate-tectonic models are presented for the thermal structure of the crust and uppermost mantle in island arc areas, and the implications of this structure for paired metamorphic belts and crystal extension behind arcs are considered. Upward and possibly horizontal tectonic transport of the glaucophane schists to the surface is necessary to preserve the high-pressure, low-temperature mineralogy and to give the arrangement of paired metamorphic belts observed around the margins of the Pacific. These vertical movements are probably associated with a deceleration or cessation of movement on the slip zone. The rate of magmatic intrusion into the upper crust required to give the high heat flow in the zone overlying the part of the slip zone on which melting occurs would result in crustal spreading behind the arc at rates up to several cm per yr in a steady-state situation. — DBV

06877 **Padgham, William Albert.** The geological structure of the Lac La Ronge region, Saskatchewan [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 253B, 1970.

06798 **Page, Virginia M.** Angiosperm wood from the Upper Cretaceous of central California, [Pt.] 3: Am. Jour. Botany, v. 57, no. 9, p. 1139-1144, illus., 1970.

Five species representing five genera are described. The specimens are part of a collection of woods from the Upper Cretaceous Panoche Formation of central California. *Lardizabaloxylon cocculoides* sp.n. resembles wood of those species of *Cocculus* of the Menispermaceae lacking included phloem. *Carpinoxylon ostryopsoides* sp.n. is similar to the wood of the Coryleae of the Betulaceae, particularly *Ostryopsis*. *Riboidoxylon cretacea* gen. et sp.n. is similar to the wood of *Ilex* of the Aquifoliaceae and also falls within the range of variation of the woods of the two closely related families, the Grossulariaceae and the Escalloniaceae. *Mulleroxylon eupomalioides* sp.n. falls well within the range of variation of the woods of the Magnoliaceae. — Author's abstract

06727 **Pak, Hasong; Beardsley, George F., Jr.; Heath, G. Ross; Curl, Herbert.** Light-scattering vectors of some marine particles: Limnology and Oceanography, v. 15, no. 5, p. 683-687, illus., 1970.

The volume-scattering function and particle size distribution of several marine sediments and species of phytoplankton were measured. The specific volume-scattering function of a single particle at a 45° scattering angle, and the mean particle cross section form a two-dimensional optical vector (β_{45}, S), which can be used to characterize the suspended matter in sea water. In general, β_{45} increases with increase in S for the biological material over the particle size range measured, 10-70 μ^2; the geological samples showed a wide range of specific scattering over the limited size range studied, 5-15 μ^2. Vertical profiles measured in the eastern equatorial Pacific and off the Oregon coast show surface values that appear to be in the biological portion of the optical vector diagram, and a smooth transition with depth to the apparent geological portion. — *from* Authors' abstract

Palmer, James E. *See* Peterson, Warren L. 00161

Peacor, Donald R. *See* Foreman, Neil. 06700

Perkins, R. D. *See* Halsey, S. D. 07002

06914 **Perry, Ed; Hower, John.** Burial diagenesis in Gulf Coast pelitic sediments [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 18, no. 3, p. 165-177, illus., tables, 1970.

In Eocene-Pleistocene shale samples from five oil wells, illite-montmorillonite dominates the mineralogy and undergoes a monotonic decrease in expandability from 80 to 20 percent montmorillonite layers with increasing depth. The interstratification changes from random to ordered at 35 percent expanded layers. Discrete illite and kaolinite phases are ubiquitous and judged detrital. Chlorite occurs in shallow water facies from only one well, and is considered detrital. Whole rock chemical analyses show no systematic variation with depth except for a decrease in Ca and Mg due to carbonate solution. In contrast, K increases with depth in clay size fractions, indicating redistribution. Detrital illite breaks down with depth, supplying K for interlayer fixation in illite-montmorillonite. Diagenetic reaction is independent of geologic age and stratigraphic boundaries. Temperature seems more important than pressure. — *from* Authors' abstract

06489 **Peterman, Z. E.; Goldich, S. S.** Early Precambrian geology of the Rainy Lake district [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 34, 1970.

Peters, David C. *See* Crosson, Robert S. 06944

06716 **Peterson, Robert W.; Cazeau, Charles J.** Lynches River sediments, South Carolina: South Carolina Div. Geology Geol. Notes, v. 14, no. 4, p. 85-96, illus., tables, 1970.

Numerous bed load samples, collected from the Lynches River and some of its tributaries, were subjected to textural and mineralogical analyses; data were evaluated for significant trends within the drainage system. Results indicate: sorting improves and mean particle diameter decreases downstream, and epidote and hornblende are the dominant transparent heavy minerals in upper reaches of the Lynches but are almost entirely replaced by a zircon-tourmaline-staurolite suite below the Fall Line. Results suggest infusion of Coastal Plain sediments into the Lynches bed load is chiefly responsible for its textural and mineralogical attributes below the Fall Line. The Lynches is too small and its drainage area in the Piedmont too restricted to deliver significant quantities of epidote-hornblende to the modern coast. — *from* Authors' abstract

00161 **Peterson, Warren L.; Moore, Samuel L.; Palmer, James E.; Smith, J. Hiram.** Geologic map of part of the La Grange quadrangle, Oldham County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-901, scale 1:24,000, text, 1971.

Construction materials are obtained in the La Grange quadrangle from the Saluda Dolomite Member of the Ordovician Drakes Formation; large deposits of sand and gravel occur in glacial outwash in the Ohio Valley. — MCM

07096 **Péwé, Troy L.** Altiplanation terraces of early Quaternary age near Fairbanks, Alaska, *in* Problemy Czwartorzedu: Acta Geog. Lodziensia 24, p. 357-363, illus., 1970.

Bedrock stepped ridges and crests in the Fairbanks area are very old altiplanation terraces, at elevations of 260 to 900 m above sea level. As they formed, frost-rived debris was shed as a solifluction blanket from the terraces down slopes to creek valley bottoms, where it was rounded in short transports by water. Considerable gravel is there, including placer gold. The altiplanation terraces, still present solifluction layers, and reworked valley gravel are now buried by loess and retransported loess of Illinoian, Wisconsin, and post-Wisconsin age. The terraces, early to middle Quaternary in age, appear to be the oldest yet reported. Knowledge of climatic conditions necessary to produce altiplanation terraces would aid in determining paleoclimatic conditions under which ancient ones formed. These conditions may exist today at 1660 m in the Yukon-Tanana upland. — *from* Author's summary and conclusions

00136 **Peychès, Ivan; Zortea, Michel.** Glass tanks as models for convection in the upper mantle: Jour. Geophys. Research, v. 76, no. 5, p. 1416-1423, illus., table, 1971.

An attempt is made to determine the conditions under which the double extrapolation from model to tank or molten glass to Earth's mantle would still be justified in spite of the enormous differences in viscosities. Observations show that "rollers" in a convection current that expand symmetrically toward the colder lateral areas of a glass tank might account for the propagation of a rift initially located over a localized source. The pitch of helical motions increases with distance from the axis. Such motions might be the cause of tensile stress at right angles to the direction of ocean-floor spreading (producing transform or wrench faults); the spreading would be due to the large recirculating movements. An experiment reversing the direction of heat flow suggests that the generally accepted downward slope of the surface current under the continental shelves in their present location might explain the rise under the rift even after the initial localized fracture-generating hot spot has disappeared. — DBV

Philpotts, J. A. *See* Schnetzler, C. C. 06850

Pickering, Dennison J. *See* Finn, W. D. Liam. 06773

06889 **Piel, Kenneth Martin.** Palynology of Middle and Late Tertiary sediments from the central interior of British Columbia, Canada [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 309B, 1970.

06605 **Pierce, Robert William.** Ultrastructure and biostratigraphy of the conodonts of the Monte Cristo Group, Arrow Canyon Range, Clark County, Nevada [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 761B-762B, 1970.

06660 **Pimm, A. C.** Leg 4 grain size results, Chap. 12 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 295-305, illus., table, 1970.

Cores from sites 23-31, on the continental shelf off South America, and the Caribbean Sea, are described. A complete list of the grain-size results is tabulated, triangle diagrams for each hole are given, and plots of sand-silt and silt-clay boundaries are included. Methods used for grain-size analysis are in the appendix to this volume. — ESL

06661 **Pimm, A. C.** Carbon carbonate results, Leg 4, Chap. 13 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 307-314, table, 1970.

Complete carbon carbonate results from all samples recovered on Leg 4 are tabulated and described by sites. Methods used are discussed here and summarized in the appendix to this volume. Most of the holes drilled on Leg 4 were very low in organic carbon, but two had consistently higher values; one, sandy turbidites with plant remains, the other, marl or chalk oozes with high glauconite content. — ESL

00129 **Pinus, G. V.** Heavy oxygen isotope of the olivine from the ultramafic rocks as indicator of their genesis: Jour. Geophys. Research, v. 76, no. 5, p. 1339-1341, table, 1971.

The isotropic composition of olivine in several types of ultramafic rocks shows variations that can be explained by the different depths of origin in the upper mantle. The δ O-18 values of olivine increase in the sequence alpine ultramafics, gabbro pyroxenite-dunite associations, and alkaline ultramafic associations. The alpine ultramafics form in the shallowest upper mantle regions, whereas the alkaline ultramafics form in deeper regions underlying stable continental crust. — Author's abstract

07062 **Pocock, Stanley A. J.** Palynology of the Jurassic sediments of western Canada — Pt. 1, Terrestrial species: Palaeontographica, ser. B. v. 130, nos. 1-2, p. 12-72, 1970; ibid., nos. 3-6, p. 73-136, illus., 1970.

An outline of the geological history of the area and a systematic account of the nonmarine palynological assemblages are given. It is shown that it is possible to divide the assemblages into a series of floral zones which are of value for purposes of dating and correlating both on a local and intercontinental scale, and that dating by means of these floral zones is in close agreement with the results of mega- and microfaunal analyses. Numerous genera and species are described and illustrated. — HRC

06616 **Podosek, Frank Anthony.** Early solar system abundances of iodine-129 and plutonium-244 from analysis of xenon in neutron-irradiated meteorites [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 768B, 1970.

Podwysocki, Melvin H. *See* Dutcher, Russell R. 06964

06878 **Poort, Jon Michael.** Stratigraphic patterns in the Sauk sequence of the western craton [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 253B-254B, 1970.

06490 **Powell, C. McA.** Structural and metamorphic history of the Marquette Synclinorium [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 35, 1970.

07036 **Pratt, Alan R.; Callaghan, Eugene.** Land and mineral resources of Sanpete County, Utah: Utah Geol. and Mineralog. Survey Bull. 85, 69 p., illus., tables, geol. map, 1970.

Sanpete County has extensive mineral resources for use as dimension stone, road construction materials and chemical minerals. Further investigation of fossil fuels should be encouraged; evidence of gas has been found, and coal mining was a pioneer industry. Deep oil testing preceded by an understanding of the complex geologic structures should be undertaken. Arable land and ground water, properly managed, could be put to better use. The human resources of the county could be developed with introduction of new industries and better management of the old ones. The spectacular scenic values and possibilities for recreational development should be explored. — Author's abstract

06667 **Presley, B. J.; Kaplan, I. R.** Interstitial water chemistry — Deep Sea Drilling Project, Leg 4, Chap. 20 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 415-430, illus., tables, 1970.

Twenty-two samples were collected from seven sites. Major components of interstitial water are tabulated. Major cations were determined by atomic absorption spectroscopy. Other methods used for individual components are also described. The samples represent a variety of environmental conditions. This variety, and the small number of samples available, makes it difficult to speculate on specific diagenetic processes affecting the interstitial water, but certain trends are apparent. Potassium, calcium, magnesium, and sodium concentrations in interstitial water give evidence of reactions having occurred in the column. Zinc is the only transition element whose concentration in interstitial water is different than that in core samples. — ESL

06879 **Price, Vaneaton, Jr.** Distribution of trace elements in plutonic rocks of the southeastern Piedmont [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 254B, 1970.

06607 **Pride, Douglas Elbridge.** Geochemistry of the Precambrian iron formation near Atlantic City, Fremont County, Wyoming [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 762B-763B, 1970.

Pritchard, A. M. *See* Hogarth, D. D. 06638

Pryor, Wayne A. *See* Hester, Norman C. 07019

06499 **Puskas, F.** Guide to the Port Coldwell alkali complex, *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 85-99, illus., 1970.

The Port Coldwell Alkali Massif is the last of a succession of igneous intrusions within an Archean volcanosedimentary belt which extends along the north shore of Lake Superior near Marathon. The Port Coldwell massif is a circular lopolith; rocks of this complex can be divided into the Main Group — gabbros and larvikites in rhythmic layers dipping inward at moderate angles — and the Secondary Group — massive saturated syenodiorites and nordmarkites, and younger locally layered unsaturated feldspathoidal syenites. Xenolithic bodies associated with the Secondary Group, west of Wolf Camp Lake, belong to the "Coubran Lake metavolcanic cap" which appears to be free-floating in the north and attached in the south. The massif has been prospected for metals, other minerals and building stones, but production abandoned. Seven stops are described in road log. — GDC

Rahn, Perry H. *See* Hoskins, Earl R. 07028

00113 **Ratcliffe, Nicholas M.** The Ramapo fault system in New York and adjacent northern New Jersey — A case of tectonic heredity: Geol. Soc. America Bull., v. 82, no. 1, p. 125-141, illus., 1971.

The Ramapo fault system forms the northwestern boundary of the Newark Triassic basin in New York and adjacent New Jersey, and is commonly attributed to Mesozoic crustal fracturing. Detailed study near the fault, however, indicates a complex his-

tory of strike-slip and block faulting, perhaps dating from late Precambrian time. Paleozoic and Mesozoic movements are recorded, and recent seismic activity suggests that the fault system may still be active. The observations thus suggest a possible tectonic longevity of some 700 m.y. The system was the locus of basic plutonism in Precambrian, Ordovician, and Triassic time, and also marks the boundary between tectonic blocks having different Paleozoic deformational histories. The fault zone thus may be part of a fundamental crustal fracture system that was active during the formation of the Appalachian orogen. The available evidence suggests that the northern end of the Reading Prong is not allochthonous. — *from* Author's abstract

Raymond, Dorothy. *See* LaMoreaux, Philip E. 06734

Raymond, William H. *See* Desborough, George A. 06897

06491 **Read, W. F.** Is the Limestone Mountain structure an astrobleme? [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 36, 1970.

Redmond, Charles E. *See* Hole, Thornton J. F. 06836

00172 **Reed, Bruce L.; Miller, Roger L.** Orientation geochemical soil survey at the Nixon Fork mines, Medfra quadrangle, Alaska: U.S. Geol. Survey Bull. 1312-K, p. K1-K21, illus., table, geol. map, 1971.

Gold lodes in the Nixon Fork area occur as small contact metamorphic deposits in limestone within a few hundred feet of a quartz monzonite contact. Bedrock is extensively ocvered by overburden, but soil sampling has revealed anomalous metal concentrations related to the lodes. Arsenic, antimony, copper, lead, and silver are the best pathfinder elements for gold. Arsenic, copper, lead, and antimony generally increase with soil depth. Silver is enriched in the A horizon. Gold is present in C-horizon samples in amounts up to 16 ppm as far as 400 feet downslope from some lodes. Anomalous metal content in C-horizon soils is generally reflected in the A-horizon soils. Sampling of A-horizon soils would be an effective method for reconnaissance geochemical prospecting in this area. — Authors' abstract

00149 **Reed, Walter E.** Reply [to comments by Stanley N. Davis on "Transport of water away from a buried heat source with special reference to hydrologic phenomena observed at Aardvark nuclear detonation" (1970)]: Jour. Geophys. Research, v. 76, no. 2, p. 633-634, 1971.

For original paper, *see* ibid., v. 75, no. 2, p. 415-430, 1970; Abs. North American Geology, June 1970.

06841 **Reid, Arch M.; Meyer, Charles, Jr.; Harmon, Russell S.; Brett, Robin.** Metal grains in Apollo 12 igneous rocks: Earth and Planetary Sci. Letters, v. 9, no. 1, p. 1-5, illus., 1970.

The rocks examined contain abundant disseminated grains of metallic Fe with a wide range of Ni and Co contents. They vary more than in terrestrial rocks and meteorites. Ni and Co are generally higher in metal grains enclosed by the earliest-formed minerals (olivine and chromite) and are lower in those associated with later phases. The metal grains do not indicate the former presence of an immiscible metal liquid but have formed by the reduction from the silicate melt. Formation of the metal grains accompanied, and may be a direct result of, the crystallization of the major phases under low oxygen partial pressures. The presence of nickel-iron grains in lunar igneous rocks indicates that metal grains in lunar soil need not be exclusively of meteoritic origin. — *from* Authors' abstract

00120 **Reid, J. B., Jr.; Frey, F. A.** Rare earth distributions in lherzolite and garnet pyroxenite xenoliths and the constitution of the upper mantle: Jour. Geophys. Research, v. 76, no. 5, p. 1184-1196, illus., table, 1971.

Spinel lherzolite occurs at Salt Lake Crater, Hawaii, intimately associated in single xenoliths with garnet pyroxenite. Rare-earth element distributions in these two-assemblage rocks are consistent with textural observations that suggest that the lherzolite has formed as residue when basaltic components were removed from the original pyroxenite by a permeating melt. Relative to lherzolite, garnet pyroxenite is the more primitive upper mantle material. — DBV

06654 **Reid, R. O.; Knowles, C. E.** An inverse tsunami problem, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 399-406, tables, 1970.

The inverse problem investigated is that of attempting to estimate the deep-water input tsunami from recordings made at or near an island. This hinges on the ability to estimate the appropriate transfer function for the site in question for a given direction of input. A numerical integration of the wave equations is being investigated for the estimation of this transfer function. So far the method has been applied only to an island of simple geometry for which analytical solution of the scattered wave field is known. The test shows some promise for extension to islands of more realistic geometry. — Authors' abstract

06824 **Reimer, G. M.; Storzer, D.; Wagner, G. A.** Geometry factor in fission track counting: Earth and Planetary Sci. Letters, v. 9, no. 5, p. 401-404, illus., table, 1970.

Fission track density determinations of external and internal counting surfaces ("2π" and 4π geometry) have been made for different glasses, apatite, zircon, sphene, and muscovite. The ratios between the two geometries range from 0.57 and 0.89 depending on the material and the etching time. Fission track ages using a factor of 0.5 between the two geometries must be corrected. — Authors' abstract

07078 **Reiser, Hillard N.** Northeastern Brooks Range — A surface expression of the Prudhoe Bay section, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. K1-K14, illus., discussion, 1970.

Structurally, the Mount Michelson-northeastern Brooks Range area is a salient consisting of E-W-trending anticlinal mountains; folding is more intense to the south, tighter folding, overturning, and faulting becoming more pronounced in that direction. Bedrock includes possibly 40,000 feet of sedimentary and weakly metamorphosed sedimentary rocks, a granitic pluton, and mafic igneous bodies. Evidence for rocks of all systems from Silurian to Quaternary is present; it is likely that Precambrian rocks are represented. The outstanding feature of the geologic record is the major angular unconformity between pre-Mississippian and Mississippian rocks, the exhumed surface of which is widely exposed. [The various rock systems are described.] — *from* Author's introduction

06887 **Reiter, Marshall Allan.** Terrestrial heat flow and thermal conductivity in southwestern Virginia [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 259B, 1970.

06880 **Reith, Howard Cartnick.** A study of earth science teachers and practices in North Dakota for the academic year 1968-1969 [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 254B, 1970.

07086 **Rennix, Mark T.** Observations of some unusual Dugway geodes: West Virginia Acad. Sci. Proc. 1969, v. 41 (West Virginia Univ. Bull., ser. 70, no. 11-3), p. 184-188, illus., discussion, 1970.

Geodes were discovered which differed greatly from the usual Dugway geodes. One geode has very little rhyolite on the surface and is irregular in shape. Another, which is shaped much like an egg, rattled inside when dug up. Upon opening, it was found to contain loose fragments of the innermost layers of crystals. These fragments were partially polished from being tumbled within the abrasive cavity of the geode. — Author's abstract

06702 **Rentzeperis, P. J.** The crystal structure of alleghanyite, $Mn_5[(OH)_2(SiO_4)]$ [with German abs.]: Zeitschr. Kristallographie, v. 132, nos. 1-2, p. 1-18, illus., tables, 1970.

The crystal structure of alleghanyite, from Bald Knob, N.C., has been determined using three-dimensional equi-inclination diffractometer data and considering its isotypism to chondrodite. The SiO_4 tetrahedron is slightly distorted. The Mn atoms occupy octahedral sites in a slightly distorted hexagonal array of 0 atoms. All Mn octahedra are highly distorted, and are of three types: Mn(1) includes one OH group, Mn(2), two groups, and no OH group belongs to the Mn(3) octahedron. These octahedra share two, three, or four edges with adjacent octahedra, and one or two edges with SiO_4 tetrahedra. Serrated zigzag octahedral chains lie on layers parallel to (010). Octahedra in chains repeat themselves periodically along the *a* axis. Adjacent chains are separated by chains of octahedral voids. Linkage is affected by isolated SiO_4 tetrahedra. — *from* Author's abstract

06730 **Rex, R. W.; Murray, B.** X-ray mineralogy studies, Leg 4, Chap. 15 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 325-369, illus., tables, 1970.

Analytical details of the X-ray mineralogy are discussed in Appendix 3 of this volume. Data presented here involve X-ray diffraction analyses of bulk samples of sediment as collected, washed, and ground to less than 15-micron size. The 2- to 20-micron fraction showed variations in minor constituents that appear in smear slides under the microscope; usually many of these are missed in bulk sample analyses. However, the latter is a better quantitative indicator of relative abundance of major constituents. Mineralogy is both diverse and uniform; diversities are associated with alternation of continental turbidites with marine pyroclastic alteration products. To these, diagenetic alteration products have been added. — ESL

Rex, Robert W. *See* Elders, Wilfred A. 06967

00138 **Rice, Alan R.** Mechanism of dissipation in mantle convection: Jour. Geophys. Research, v. 76, no. 5, p. 1450-1459, illus., tables, 1971.

Situations in which dissipation can be neglected in natural convection are rare. Dissipation cannot be neglected if there are volumetric sources in the fluid. Criteria now used to determine the influence of dissipation are contradictory; a new criterion is suggested. Dissipation is analogous to the regeneration phenomenon encountered in avalanche breakdown in electrical devices (e.g., reference diodes and glow tubes). The nonlinearity imposed by dissipation yields two solutions to the velocity field. Both solutions are physically realized in electronic apparatus and are responsible for regeneration phenomena and multi-state systems such as relaxation oscillators. If the second solution is physically realized in natural convection, periodic nonsinusoidal behavior might be anticipated in continental drift and sea-floor spreading. — Author's abstract

06692 **Richter, D. H.; Eaton, J. P.; Murata, K. J.; Ault, W. U.; Krivoy, H. L.** Chronological narrative of the 1959-60 eruption of Kilauea Volcano, Hawaii: U.S. Geol. Survey Prof. Paper 537-E, p. E1-E73, illus., table, 1970.

The 1959-60 eruption of Kilauea Volcano began in Kilauea Iki, a collapse crater adjacent to the main summit caldera, and consisted of 17 separate eruptive phases of 1 week to 1.75 hours duration. At cessation of activity on December 20, 1959, Kilauea Iki held 50 million cu yd of lava, 335 feet deep. A flank eruption began near Kapoho on Kilauea's east rift zone on January 14, 1960; 160 million cu yd of lava covering 2500 acres erupted in the next 37 days. Concurrent with beginning of the flank eruption the summit area deflated rapidly. On February 7, the floor of Halemaumau, a deep crater in Kilauea caldera, collapsed because of withdrawal of the still fluid core of the 1952 lava lake. Two smaller collapses on March 9 and 11 in Halemaumau ended the 1959-60 eruption. — VSN

Rickson, K. O. *See* Gay, P. 06845

07079 **Rickwood, Frank K.** The Prudhoe Bay field, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. L1-L11, illus., 1970.

The stratigraphy and structure of the Prudhoe Bay field is discussed in relation to its position in the larger framework of the entire region of northern Alaska. A description is given of some details of the field including its structure, trapping mechanism, and oil characteristics. The sedimentary section consists of two main sequences — the Lower Sequence from Mississippian to lowermost Cretaceous in age, and the Upper Sequence from Lower Cretaceous to Tertiary in age, separated from each other by an important and widespread angular unconformity, marking the beginning of the rise of the Brooks Range, deepening of the Colville basin, and formation of the Barrow arch. The reservoir beds developed on the north flank of the depositional basin at the southern limit of the northward downwarp toward the Arctic Ocean. It is basically a stratigraphic trap with Triassic reservoir sealed by unconformable Lower Cretaceous shales. — VSN

06492 **Ridler, R. H.** Archaean volcanic stratigraphy of the Kirkland-Larder Lakes area of northeastern Ontario [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 37-39, illus., 1970.

06671 **Riedel, W. R.; Sanfilippo, Annika.** Radiolaria, Leg 4, Deep Sea Drilling Project, Chap. 24 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 503-575, illus., tables, 1970.

Radiolarians occur in Cretaceous deposits at Site 24, off Brazil, and Site 28 on the Outer Ridge between the Puerto Rican Trench and Nares basin, and in the Eocene at Sites 27-29, possibly in Oligocene at Site 27, and in Miocene at Sites 30-31, all in the Caribbean Sea. Stratigraphic correlation by radiolarians is not as routine as with foraminifera and calcareous nannoplankton and, therefore, all information on occurrences of the species is given in this chapter, with information necessary to justify the correlation. To describe the stratigraphic positions of radiolarian sediments obtained on Leg 4, Cenozoic radiolarian zonation is outlined. In this outline, the approximate relation of calcareous microfossil zones to radiolarian zones is indicated. A number of new taxa are described, and some generic assignments of previously known species are changed. — ESL

Riedel, William R. *See* Bader, Richard G. 06657

Robinson, Paul D. *See* Fang, Jen-Ho. 06974

Robinson, Paul T. *See* Elders, Wilfred A. 06967

Rocha-Campos, Antonio. *See* Wanless, H. R. 06708

06908 **Roche, J. E.; Carozzi, A. V.** Petrography of back-reef carbonates — Traverse Group (Givétian) of the northern part of the Southern Peninsula of Michigan [with French abs.]: Centre Recherches Pau Bull., v. 4, no. 1, p. 137-189, illus., table, 1970.

Samples were collected from eight carbonate-rock sections, and petrographic examination revealed that all consist of two distinct but related groups of microfacies, interbiohermal and lagoonal. The first represents a marine subtidal to intertidal environment, slightly restricted by development of coral-stromatoporoid bioherms. The microfacies are dark and can be divided into eight types. The second group represents a more restricted lagoonal environment, intertidal to supratidal; and developed when isolation occurred from intense biohermal growth in the first environment. These microfacies are light-colored, and include four types. The relationship between these groups expresses oscillations within a broad back-reef environment between the Michigan basin shoreline and an inferred barrier basinwards. It resembles the Devonian reef complexes of Australia's Canning basin. — *from* Authors' abstract

06608 **Roche, James Edward.** Petrography of back-reef carbonates — Traverse Group (Givétian) of the northern part of the Southern Peninsula of Michigan [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 763B, 1970.

Roche, Michael B. *See* McIntyre, Andrew. 06697

06863 **Rochester, M. G.** Coremantle interactions — Geophysical and astronomical consequences [abs.], *in* Geophysical studies on the evolution of the Earth's deep interior — A symposium, Madrid, 1969, Proc.: Physics Earth and Planetary Interiors, v. 2, no. 5 (spec. issue), p. 381, 1970.

Romanov, D. P. *See* Fedoseev, A. D. 06508

07066 **Romberger, S. B.; Barnes, H. L.** Ore solution chemistry — [Pt.] 3, Solubility of CuS in sulfide solutions: Econ. Geology, v. 65, no. 8, p. 901-919, illus., tables, 1970.

Solubility of covellite (CuS) was measured in aqueous sulfide solutions up to 4.95 molal HS-, pH 3.5 to 13.5, 20° to 200°C, and 2 to 83 atm total pressure. Three important copper-bisulfide complexes are formed, the stability of which depends on pH and temperature. Reactions are given which represent formation of complexes predominating under given conditions. Assuming that solubility of at least 10 ppm Cu is necessary for significant ore transport, bisulfide complexes are potential ore carriers at 200°C and total sulfur concentration of 0.25 molal, or greater, at neutral to weakly alkaline pH's. Covellite transported as bisulfide complexes would be deposited by any mechanism that lowers stability, such as decrease in temperature or pH, oxidation, or dilution. Conditions of deposition obtained in the laboratory agree well with those deduced from natural occurrences. — *from* Authors' abstract

07053 **Root, J. D.** Index to current geologic maps of Alberta: Research Council Alberta Rept. 70-2, 20 p., illus., 1970.

This index, a compilation of currently available geologic map coverage published by the Research Council of Alberta and Geological Survey of Canada, does not include maps published prior to 1930. Maps showing special aspects of outcrop of subsurface bedrock geology associated in most cases with petroleum exploration or mineral evaluation studies, have been omitted. — MCM

07067 **Rose, Arthur W.** Zonal relations of wallrock alteration and sulfide distribution at porphyry copper deposits: Econ. Geology, v. 65, no. 8, p. 920-936, illus., tables, 1970.

Lead and sulfur isotope data as well as the sulfide-silicate alteration zoning typical of most porphyry copper deposits "suggest that ore fluid traveled outward from the porphyry, starting at high temperatures and relatively high K:H ratios in the orthoclase field, thereby forming the biotite-orthoclase alteration" in the central zone. To form the surrounding zone of strong sericite alteration, cooling of the fluid is the most probable means of changing mineral equilibria. To obtain this, copper concentrations in ore fluid of 1,000 ppm or higher are suggested with cooling by expansion or mixing with ground water to bring temperatures of ore fluid into the muscovite stability field. — VSN

06916 **Rose, W. I., Jr.; Stoiber, R. E.; Bonis, S. B.** Volcanic activity at Santiaguito volcano, Guatemala, June 1968-August 1969: Bull. Volcanol., v. 34, no. 1, p. 295-307, illus., tables, 1970.

Information regarding activity of Santiaguito dome, in western Guatemala, for the period June 1968-August 1969, has been derived from photos taken repeatedly at strategic locations, weekly geologic observations from a nearby lookout, and ten expeditions to the mountain. Activity continues at the principal Caliente vent. Ash, bombs and gas eruptions have been interspersed with repeated extrusion and blasting away of small plug domes. At the subsidiary vent, El Brujo, dome extrusion and accompanying avalanching, so prominent in 1967-68, has declined since late 1968. The minimum volume of the El Brujo dome (formed since 1966) is estimated to be 8.5 million cu m. — Authors' abstract

06683 **Rosenkrantz, Alfred.** Marine Upper Cretaceous and lowermost Tertiary deposits in West Greenland — Investigations before and since 1938 [with Danish abs.]: Dansk Geol. Foren. Medd., v. 19, no. 4, p. 406-453, illus., 1970.

Investigations of marine beds in the Cretaceous-Tertiary sedimentary basin of West Greenland began in 1938 with the first of a long series of expeditions. The presence of several stages not known before 1938, viz. Cenomanian? Upper Turonian, Coniacian, Lower Santonian, Maastrichtian and Danian, has been demonstrated by the character of the marine faunas. Ages of Heer's classic fossil floras have been fixed more exactly, excepting the Kome flora and interbasaltic Ivssorigsoq flora which, on phytopaleontological evidence, are probably respectively of Barremian-Aptian and not younger than Eocene age. Marine fauna from throughout the succession is summarized, and paleogeographic implications discussed. A few fossils of particular interest have been figured and provided with a preliminary diagnosis, viz. a remarkable cirriped from the Santonian-Campanian and some important Danian echinoids and molluscs. — *from* Author's abstract

00155 **Ross, David A.** Mass physical properties and slope stability of sediments of the northern Middle America Trench: Jour. Geophys. Research, v. 76, no. 3, p. 704-712, illus., 1971.

The shear strength, porosity, and density of 32 cores from the northern part of the Middle America Trench have been determined. A stability analysis using the shear strength data indicates that the sediments are generally stable except on the landward flank of the trench where slumping is possible under the slope conditions observed. Comparisons of gravity-piston core pairs indicate differences in porosity and shear strength that are the result of the coring procedure. Clearly better coring devices are needed before *in situ* conditions are approached. Porosity and the log of shear strength are inversely related, and porosity has a positive relationship to percent clay. The specific gravity of the sediments is 2.66 g per cu cm (at zero porosity), a value similar to that of other areas with a high rate of terrigenous position. — *from* Author's abstract

06790 **Ross, G. J.; Kodama, H.** Differential release of potassium from interstratified mica clay minerals as related to probable differences in their mica layer components [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 18, no. 3, p. 151-156, illus., tables, 1970.

Release of potassium by extraction with solutions containing sodium tetraphenyl boron or by leaching with 0.1 N barium chloride seemed to be related to the nature of the mica layers in the interstratified minerals studied. The rate of potassium release was lower when the calculated $Si:Al^4$ ratio of the mica component layers resembled muscovite and higher when this ratio was intermediate between muscovite and pyrophyllite. This supported a recent hypothesis that the composition and structure of the mica component layers may vary in different interstratified minerals of similar total chemical composition. — Authors' abstract

Rothwell, W. Thomas, Jr. *See* Bader, Richard G. 06657

06507 **Rouxhet, Paul G.** Kinetics of dehydroxylation and of OH-OD exchange in macrocrystalline micas: Am. Mineralogist, v. 55, nos. 5-6, p. 841-853, illus., 1970.

The quantitative interpretation of the OH and OD stretching bands of muscovite single crystals allowed measurement of the kinetics of dehydroxylation under vacuum and of deuteration under high D_2O vapor pressures in the temperature range of 580-670°C. The procedure used gives an estimation of the diffusion coefficient limiting the progress of the reaction in the c^* direction. The rates of both reactions are similar. The diffusion coefficients for deuterium, measured in the c^* direction, are of the same order of magnitude for muscovite and phlogopite. They are the same for the two types of hydroxyls in biotite. Therefore, there is no relation between the mobility of protons or hydroxyls in micas and the real thermal stability. — *from* Author's abstract

06751 **Rudwick, Martin J. S.** The strategy of Lyell's *Principles of geology*: Isis, v. 61, pt. 1, no. 206, p. 5-33, illus., 1970.

Rudwick analyzes Lyell's "Principles of geology" (1830-1833), chapter by chapter, pointing out the strategy developed by Lyell in support of his uniformitarian system of earth history, for which he used the Tertiary epoch as the chief testing ground, and in opposition to the catastrophist and directionalist views held by his contemporaries. The influences of Hutton on Lyell and of Lyell on Darwin are discussed. — VMJ

Ruef, Michael H. *See* Bader, Richard G. 06657

06541 **Runcorn, S. K.** (editor). Palaeogeophysics: London and New York, Academic Press, 518 p., illus., tables, 1970.

The 50 papers in this book comprise the proceedings of the 1968 NATO Advanced Study Institute meeting on paleogeophysics at the University of New Castle upon Tyne. Eleven papers are cited separately. — VSN

06609 **Russell, Kenneth Lloyd.** Geochemistry and halmyrolysis of clay minerals, Rio Ameca, Mexico [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 763B, 1970.

06881 **Rutstein, Martin Stuart.** The partitioning of iron between natural and synthetic wollastonite, clinopyroxene and garnet [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 255B, 1970.

00132 **Ryabinin, Yu. N.; Beresnev, B. I.; Martinov, E. D.** Mechanical properties and proceeses in solids under high pressure: Jour. Geophys. Research, v. 76, no. 5, p. 1370-1375, illus., 1971.

Increased plasticity of brittle solids resulting from pressure and its causes are considered. The deformation curves of rocks under high pressures and the pressure effect on rock strength within the strengthening range are defined. Pressure effect on rock creep is investigated. The deformation value and deformation speed as a function of time are shown, and the deformation speed and viscosity coefficient as a function of stress are studied. The deformation value, deformation speed, and viscosity coefficient as functions of pressure are also investigated. The viscosity values during long-period tests under pressure are determined. — Authors' abstract

Sacks, I. Selwyn. *See* Dorman, LeRoy M. 06957

Sainsbury, C. L. *See* Desborough, George A. 06893

Sanfilippo, Annika. *See* Riedel, W. R. 06671

Sartori, Franco. *See* Merlino, Stafano. 00166

Sato, Motoaki. *See* Huebner, J. Stephen. 06511

Saunders, W. Bruce. *See* Furnish, W. M. 00173

Savin, Samuel M. *See* Hecht, Alan D. 07016

Saxena, Surendra K. *See* Mueller, Robert F. 06794

06666 **Sayles, F. L.; Manheim, F. T.; Chan, K. M.** Interstitial water studies on small core samples, Leg 4, Chap. 19 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 401-414, tables, 1970.

Studies of waters squeezed and analyzed on shipboard and in the shore laboratory show good agreement except for some aberrations whose sources are hard to track down. Pressure effects are not significant, but temperature effects are, but less so than diagenetic reactions. Chloride, sodium, and bromide remain relatively constant with changing depth; but large depletions with respect to normal sea water occur in calcium, magnesium, potassium, and sulfate in most of the cores. Large enrichments

of calcium and lithium occurred in Holes 24 and 24A, off Brazil. Depletion of several constituents in pore waters in Hole 26, Vema fracture zone, caused a drop in total salt content, but no real dilution effects are involved as chloride and sodium values remain typical. — ESL

Sayles, Fred L. *See* Bader, Richard G. 06657

06673 **Sayles, Fred L.** Preliminary geochemistry, Chap. 26 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 645-655, illus., table, 1970.

This section is an evaluation and synthesis of Leg 4 shipboard data. It appears that contamination by sea water due to disturbance during coring is not a problem. The effects of squeezing on salinity of pore water is discussed, and Eh and *p*H measurements of interstitial water described. At two sites, CO_2 contents below bottom water values were noted, and possible explanations for its loss are offered. — ESL

Scheidegger, A. E. *See* Thakur, T. R. 06932

Schmid, Werner E. *See* Soydemir, Cetin. 06778

06590 **Schmidt, Birger.** Settlements and ground movements associated with tunneling in soils [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 671B-672B, 1970.

Schmitt, R. A. *See* Wakita, H. 06848

Schmitt, Roman A. *See* Wakita, Hiroshi. 06838

00159 **Schnabel, Robert W.** Surficial geologic map of the Southwick quadrangle, Massachusetts and Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-891, scale 1:24,000, sections, text, 1971.

Prior to the advance of the last continental glacier, topography of the Southwick quadrangle was similar to its present state, except that many hills were higher, valleys deeper, and slopes steeper. Smoothing by ice movement was both erosional and depositional; oldest glacial deposits are dense, compact gray till. As climatic conditions changed, the ice front slowly retreated by melting both downward and northward. Sequences of graded deposits occupy south-trending valleys and probably formed contemporaneously. Swamp deposits and alluvium represent material accumulated since the glaciers melted. Nearly all glacial deposits are of economic importance, mainly to the construction industry, as sources of fill and concrete aggregate. — MCM

06850 **Schnetzler, C. C.; Philpotts, J. A.; Bottino, M. L.** Li, K, Rb, Sr, Ba and rare-earth concentrations, and Rb-Sr age of lunar rock 12013: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 185-192, illus., table, 1970.

The light and dark colored portions of 12013 are characterized by two distinct trace element patterns. The light-colored portions are lower in rare earths, slightly lower in Sr, the same in Li and higher in K, Rb, and Ba when compared to the dark-colored portions. The dark material appears to represent a late liquid in the normal igneous differentiation scheme suggested by the other lunar rocks; the light-colored material may have had a more complex history. Comparisons of trace element abundances of Apollo 12 igneous rocks and soil suggest that the dark material of 12013 may constitute an important component of the soil. The best-fit isochron to nine data points yields an Rb-Sr age of 4.1 $\pm$ 0.2 m.y. with an initial ratio of 0.704 $\pm$ 0.002. — Authors' abstract

Schoon, C. L. *See* Carlisle, V. W. 07054

Schreiber, Edward. *See* Fox, Paul J. 06981

00137 **Schubert, Gerald; Turcotte, D. L.** Phase changes and mantle convection: Jour. Geophys. Research, v. 76, no. 5, p. 1424-1432, illus., 1971.

In a two-phase fluid layer heated from below, two instability mechanisms are present, the ordinary Rayleigh instability associated with thermal expansion, and a phase change instability driven by the density difference between the phases. A stability analysis is presented for the combined effects of these instability mechanisms, and the critical Rayleigh number is determined as a function of the properties of the phase transition. The results are applied to the olivine-spinel phase change in the mantle, and it is concluded that this phase change in the presence of a negative temperature gradient may intensity deep mantle convection. The elevation of the phase-change boundary within the descending cold lithospheric plate at ocean trenches is a finite amplitude example of the phase-change instability. The additional gravitational body force on the slab due to the elevation of the phase boundary is comparable to that of thermal contraction. — Authors' abstract

07105 **Schwerdtner, W. M.** Distribution of longitudinal finite strain in lenticular boudins and bending folds: Tectonophysics, v. 9, no. 6, p. 537-545, illus., 1970.

Lenticular boudins and bending folds are important tectonic structures, characterized by similar patterns of heterogeneous finite strain. Due to limited information obtainable from distorted layers, neither principal magnitudes nor principal directions of strain can be determined at any point. However, relative magnitudes of cross-sectional extension parallel to layering can be calculated in cylindrical and discoidal boudins and folds. Throughout discoidal structures, directions of maximum tangential extension are radially oriented, whereas they lie in the cross-sectional plane of cylindrical structures. The longitudinal-strain components perpendicular to that plane are intermediate, and may vary on a given layering surface as well as from layer to layer. The present analysis assumes that these variations are negligible. — *from* Author's abstract

Sclater, John G. *See* Wimbush, Mark. 00154

06755 **Scopel, Louis J.** Pressure injection disposal well, Rocky Mountain Arsenal, Denver, Colorado, *in* Engineering seismology — The works of man: Geol. Soc. America Eng. Geology Case Histories, no. 8, p. 19-24, illus., 1970.

The pressure injection industrial waste disposal well at the Rocky Mountain Arsenal, 10 miles northeast of Denver, was drilled to a depth of 12,045 feet in Precambrian gneiss, penetrating Tertiary through Pennsylvanian sediments which are in normal sequence and show minor variations in thickness and lithology from sections in adjacent areas. The occurrence in this part of the Denver Basin of pre-Pennsylvanian sediments, possibly Ordovician in age, was unexpected. Lost circulation was a major drilling problem in Paleozoic sediments and Precambrian gneiss, as were slow penetration rates due to induration of the former. Permian and Pennsylvanian sediments are fractured and have a rock matrix of low porosity and permeability. The latter contain low-pressure reservoirs. — *from* Author's abstract

06882 **Scrudato, Ronald John.** Kaolin and associated sediments of east-central Georgia [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 256B, 1970.

Sebastyan, G. Y. *See* Meyerhof, G. G. 06740

06736 **Seddon, George.** Meteor Crater — A geological debate: Geol. Soc. Australia Jour., v. 17, pt. 1, p. 1-11, illus., 1970.

The distinctive methodology and strategy of research and characteristic style of argument in the field of geology are illustrated by the debate over the origins of Meteor Crater, Arizona. It has been hypothesized to be either a cryptovolcanic or a meteorite impact structure. Since Gilbert, in 1896, decided it was cryptovolcanic, new evidence has come from study of other large terrestrial craters, more detailed study of the crater itself and of its regional context, and from theoretical and experimental sources such as ballistic theory, nuclear explosion, and experimental mineralogy and petrology. The interaction between the three kinds of evidence is il-

lustrated. Meteor Crater is now considered to be a paradigm meteorite crater. — *from* Author's abstract

07040 **Seddon, George.** Pre-Chappel conodonts of the Llano region, Texas: Texas Univ. Austin Bur. Econ. Geology Rept. Inv. 68, 130 p., illus., tables, 1970.

Conodont faunas from the Ordovician Ellenberger Group to the Upper Devonian-Lower Mississippian Houy Formation are used to clarify local stratigraphic relations and to confirm or revise correlations of previous workers. The Devonian conodont assemblages are commonly mixed by stratigraphic leakage, condensation, and reworking; discrimination criteria are reviewed. The Pillar Bluff Limestone contains the first early Siegenian conodont fauna described from North America. A discontinuous Middle Devonian conodont record is described from the Stribling, Bear Spring, and Zesch Formations, a Givetian limestone, and crack-filling faunas of four zones previously described from Illinois Basin and Germany; marine transgression from the east is suggested. The upper unit of the Houy contains a mixed fauna of Frasnian-Famennian and middle to early late Kinderhook species, also found in the lowest zone of the Chappel Limestone. — VMJ

Seed, H. Bolton. *See* Dezfulian, Houshang. 06774

Seitz, M. *See* Burnett, D. S. 06846

Sellers, G. A. *See* Duke, M. B. 06963

06573 **Seychuk, J. L.** Load tests on bedrock [with French abs.]: Canadian Geotech. Jour., v. 7, no. 4, p. 464-470, illus., 1970.

Load tests involving the use of a steel plate, a concrete socket, and full-scale concrete piles were carried out at two separate sites in Ontario to determine the load bearing characteristics of shale and limestone bedrock. It was found that the essentially sound bedrock behaved as an elastic material under the maximum applied pressure of 260 tons per sq ft (254×10^4 kg per m^2). In addition to the vertical load tests on the rock, a lateral pile load test was carried out to evaluate the modulus of horizontal subgrade reaction of the fissured clay overburden at one of the sites. — Author's abstract

Shah, K. R. *See* Filby, R. H. 06554

Shaver, Robert H. *See* Morgan, James P. 06705

Shaw, R. P. *See* Carrier, G. F. 06653

Shelton, J. W. *See* Matalucci, R. V. 06732

06633 **Shimazaki, Hidehiko; Clark, L. A.** Synthetic FeS_2-CuS_2 solid solution and fukuchilite-like minerals: Canadian Mineralogist, v. 10, pt. 4, p. 648-664, illus., tables, 1970.

Reports of copper-bearing pyrite and other minerals near the FeS_2-CuS_2 join may be better understood in the light of experiments described here. Hydrothermal synthesis revealed an extensive solid solution series. The edge of this solid solution, which has pyrite structure, varies with composition. The solid solutions may be thermodynamically unstable but can form and persist metastably in nature. A new analysis is given for fukuchilite from the Hanawa Mine, Japan, which contains uniformly distributed blebs of pyrite and covellite; this assemblage possibly formed by decomposition of an earlier phase whose composition is given. Evidently fukuchilite can vary considerably from the published composition. — DBV

06866 **Shoemaker, Robert Earl.** Pollen and spores of the Judith River Formation (Campanian), central Montana [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 85B-86B, 1970.

06765 **Shopland, Robert C.** Portable 30-day unattended system for recording earth strain in a 66-db range: IEEE Trans. Geosci. Electronics, v. GE-8, no. 4, p. 295-305, illus., table, 1970.

A portable strainmeter system is described and illustrated that is designed to detect earth strains of 5×10^{-10} or smaller over a horizontal interval of 6 m in the period range 10 sec to dc and to record signals on magnetic tape. Step strains exceeding 1×10^{-8} are recorded on a low-gain channel; quasi-static step strains as large as 1×10^{-4} and residual strains as small as 5×10^{-10} are detected by a variable-capacitance transducer and recorded on the high-gain channel. The system is designed to record the main shock and aftershocks from earthquakes and explosions of Richter magnitude 6.5 at distances of 30 to 120 km. Instrumentation consists of a strainmeter in a trench or tunnel, a recording facility, thermoelectric generator and fuel supply, and a service vehicle with control and service instrumentation. Weight of the system when packaged is about 500 kg and volume about 3.5 m^3. — VSN

06610 **Siddiqui, Shamsul Hasan.** Hydrogeologic factors influencing well yields and aquifer hydraulic properties of folded and faulted carbonate rocks in central Pennsylvania [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 764B, 1970.

Signer, P. *See* Begemann, F. 06821

06892 **Sinclair, A. J.; Woodsworth, G. J.** Multiple regression as a method of estimating exploration potential in an area near Terrace, B.C.: Econ. Geology, v. 65, no. 8, p. 998-1003, illus., tables, 1970.

An area near Terrace, B.C., for which reserve and production information for 50 mineral deposits was available, was divided into 128 4-mile by 4-mile cells by random positioning of an appropriate grid. Geologic variables were measured and estimates of value obtained for each cell were stated in terms of tonnage, average value per ton, and total value. In two control areas of 35 and 28 cells measured variables were transformed by means of relatively simple transformations to produce near-normal frequency distributions. Linear equations were then obtained by stepwise multiple regression using various estimates of *value* as the dependent variable, and geologic measurements as independent variables. Equations obtained for cell data from one area appear reasonable geologically and statistically and are applied to remaining cells to estimate 'exploration potentials' or values. — *from* Authors' abstract

06776 **Singh, Awtar.** Shear strength and stability of man-made slopes: Am. Soc. Civil Engineers Proc., v. 96, paper 7652, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 1879-1892, illus., 1970.

A new graphic method of expressing slope stability analysis, in which equal Factor of Safety contours are drawn for a given slope for all values of angle of internal friction and cohesion intercept of the slope material, is presented. It facilitates study of effect of soil strength variation on stability of such slopes. It is shown that choice of strength parameters overrides choice of method of slope stability computation. Procedures are outlined for optimum economic design of a slope; also for bedding plane failure analysis in multilayered system. Stability charts for balanced factor of safety for man-made slope, included for all practical value of shear strength parameters, can be used for cases when a relatively higher margin of safety is required in cohesion or in friction. — *from* ASCE abstract

06624 **Slade, D. V.; Gauger, J.; Vali, V.** Laser interferometer measurement on Kern River fault, *in* Laser applications in the geosciences (J. Gauger and F. F. Hall, Jr., editors) - symposium, Huntington Beach, Calif., 1969, Proc.: North Hollywood, Calif., Western Periodicals Co., p. 163-184, illus., table, 1970.

A multicomponent laser interferometer strain meter installed across the Kern River Fault in California has yielded information on a wide frequency-bandwidth of earth motion, including those due to gross shearing, tidal forces, atmospheric effects and underground nuclear tests. An amplification of strains, over those measured on bedrock, is interpreted as being due to the essential fluid nature of material in the fault zone. — Authors' abstract

00169 **Sloan, C. E.; Garber, M. S.** Ground-water hydrology of the Mescalero Apache Indian Reservation, south-central New Mexico: U.S. Geol. Survey Hydrol. Inv. Atlas HA-349, scale 1:125,000, section, tables, text, 1971.

The map sheet contains a generalized geologic map and section and a map showing water levels and locations of wells and springs in the Mescalero Apache Indian Reservation; data on selected springs and wells are tabulated. Depth to ground water ranges from a few feet to 900 feet; water-level altitudes range from 5,400 to 8,000 feet. The Permian Yeso Formation is the most extensive aquifer with yields from 1 to more than 500 gpm. Eight wells obtain water from the Permian San Andres Formation with yields from about 10 to 200 gpm of generally hard water. Tabulated chemical analyses indicate water is generally of the calcium-magnesium sulfate or bicarbonate type with hardness ranging from 300 to 2,000 mg/*l*. — MCM

06883 **Smith, Alan Lewis.** Petrology of Quaternary basic lavas of California and a note on sphene-perovskite parageneses [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 256B, 1970.

Smith, Bernice Y. *See* Childers, Barbara S. 07037

Smith, Charles G., Jr. *See* Wintz, William A., Jr. 07109

Smith, J. Hiram. *See* Peterson, Warren L. 00161

06545 **Smith, Peter J.** The intensity of the ancient geomagnetic field, A summary of conclusions, Chap. 10 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 79-90, illus., tables, 1970.

Conclusions are summarized which may be drawn from an analysis of all ancient geomagnetic field intensity data available up to the end of 1967. It comprises an updating and reassessment of conclusions derived from a previous analysis (Smith, 1967) based on data available up to June 1966. No consideration is given to experimental techniques. The most important conclusion drawn is that the geomagnetic dipole moment fluctuates in strength within any given polarity; the quasi-period of fluctuation within the past few thousand years is of the order of 10,000 yr. The amplitude of fluctuation is about ±50 percent. — VSN

06645 **Sokolowski, T.; Miller, G.** Identification of source region from a single seismic record, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 135-147, illus., tables, 1970.

Seismic records obtained at a given station from earthquakes within a small source region are sometimes similar. If this similarity is consistent, it may be possible to identify in real time the particular fault system in which an earthquake occurs. As net ground motion along a given fault is typically consistent, it should be possible to improve the estimation of tsunami generation. Forty seismograms representing six seismic regions were digitized and spectrums were computed for the duration between P and PP for three selected recording stations. Simple linear correlations were computed between an unknown spectrum and the average spectrum for each of the groups; for some source regions, this was a definitive test. A method of "pattern recognition" which always worked is outlined; further work is being done. A much larger data sample will perhaps demonstrate the potential utility of this type of epicenter determination. — DBV

06621 **Sommer, Sheldon Emanuel.** Characterization and application of cathodoluminescence from manganese activated carbonate minerals [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 828B, 1970.

06761 **Sommers, David A.** Put hydrogeology into planning: Ground Water, v. 8, no. 6, p. 2-7, 1970.

Planning of our environment requires close teamwork among diverse professions and organizations, and hydrogeology should be represented on planning boards. The

value of hydrogeologic maps in environment planning, and ways in which they may be combined with other factors to make suitability maps are pointed out. Areas in which hydrogeology can be used include transportation, water resources, and waste disposal. This last, includes sanitary landfills for solid wastes, individual septic systems, surface spreading of waste water, and underground liquid waste disposal by injection wells. The hydrogeologist should make recommendations to the planning board so that it is aware of the risks involved in deviating from these recommendations. Hydrogeologists must become involved and active in planning, and university curricula must be improved. — ESL

Souter, J. Edwin. *See* Wanless, H. R. 06708

06778 **Soydemir, Çetin; Schmid, Werner E.** Deformation and stability of viscoelastic soil media: Am. Soc. Civil Engineers Proc., v. 96, paper 7708, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 2081-2098, illus., 1970.

Linear viscoelasticity is a more realistic representation than linear elasticity in studying deformation and stability problems of saturated cohesive soil media. The linear viscoelastic model is incorporated in terms of volumetric and deviatoric components. Elastic-viscoelastic correspondence is used to obtain time-dependent displacement and stress fields. Limitations of the correspondence principle are investigated quantitatively in parallel to stress level and overconsolidation ratio. Factor of safety for stability is considered as ratio of time-dependent octahedral shear strength to time-dependent octahedral shear stress; hence, a viscoelastic medium may experience a stable state upon application of a particular boundary loading and yet may bring itself into an unstable state with time even though the shear strength is (or is not) exhibiting an increase during the interval. This is demonstrated for a strip surface loading and a plane strain problem. — *from* ASCE abstract

06731 **Spangler, D. P.; Wallace, D. E.** A simple method for the in situ determination of alluvial densities: Eng. Geology, v. 4, no. 4, p. 335-340, illus., tables, 1970.

Alluvial density is an important parameter in hydrogeologic surveys. These density values are often difficult and expensive to obtain, especially in the large Basin and Range province of the southwestern United States. Various methods are available for obtaining densities; however, many are complex and involve expensive and cumbersome equipment. In most cases, in situ densities can be determined by the shallo core-barrel method, which can be used to obtain both wet and dry density values. Values obtained are well within the accuracy limitations demanded by exploratory hydrological or geophysical surveys. Equipment needs and sample procedures are simple and inexpensive. — Authors' abstract

06676 **Stanley, Kenneth Oliver.** Tectonic and sedimentologic history of the Lower Jurassic Sunrise and Dunlap Formations, west-central Nevada [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 764B-765B, 1970.

Staples, Lloyd W. *See* Evans, Howard T., Jr. 06972

Stearns, David W. *See* Friedman, Melvin. 06984

Stephens, Jerry C. *See* Christensen, Cleo M. 06563

Stevens, R. K. *See* Church, W. R. 00139

06630 **Stevenson, John S.; Stevenson, Louise S.** Manganese nodules from the Challenger Expedition at Redpath Museum: Canadian Mineralogist, v. 10, pt. 4, p. 599-615, illus., tables, 1970.

Manganese nodules from Stations 252 and 281 of the Challenger Expedition of 1875, recently discovered in the Redpath Museum of McGill University, are typical of two areas in the central Pacific (save for dehydration and other changes during storage). The principal manganese mineral in the nodules from Station 252 was 10 A manganite, from Station 281, δ manganite. Chemical, optical, and X-ray data were corre-

lated with the detailed picture of the occurrence and quantities of elements in the nodules by means of electron microscope studies. In all cases Fe and Mn had an antithetical relationship, and Ni and Cu were associated with the manganese. Crystallization of the manganese phases is thought to have provided a mechanism of formation of segregations which were further enriched through chemical scavenger action as long as ocean floor conditions permitted. — DBV

Stevenson, Louise S. *See* Stevenson, John S. 06630

Stoiber, R. E. *See* Rose, W. I., Jr. 06916

Stokes, W. L. *See* Thompson, A. E. 07038

06546 **Stone, D. B.** Paleosecular variation in Alaska, Chap. 13 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 117-126, table, illus., 1970.

In studies of paleosecular variation of the magnetic field it is important to be able to estimate the total time span of the lava series involved and also the distribution with respect to time of individual flows within this period. Various techniques used in estimating these times are discussed; it is important to sample sections where all flows are demonstrably in sequence. Collecting and orienting techniques used in paleosecular variation collections in Alaska are described. Studies on one-inch diameter cores from the following sites are discussed: Mt. Edgecombe on Krusov Island west of Sitka, Mt. Griggs near the upper end of the Valley of Ten Thousand Smokes, and Wait Creek, Castles I and II, and Air II in the Wrangle Mts. area. Results, including dispersion, mean declination and inclination and virtual pole positions, are given in a table. — VSN

06787 **Stormer, J. C., Jr.; Carmichael, I. S. E.** The Kudo-Weill geothermometer and porphyritic acid glasses: Contr. Mineralogy and Petrology, v. 28, no. 4, p. 306-309, illus., 1970.

The compositions of the cores and margins of the plagioclase phenocrysts in glassy acid rocks have been used to derive equilibration temperatures with their enclosing liquids using the Kudo-Weill geothermometer. The equilibration temperatures inferred from the compositions of the feldspar margins at 0.5 kilobars water pressure, or less, agree well with the temperatures obtained from the coexisting iron-titanium oxide microphenocrysts. These low water pressures are supported by the water fugacities deduced from the coexisting biotite-magnetite-sanidine assemblages. Acid magma represented by these rocks has a crystallization interval in excess of 100°C and liquidus temperatures of above 900° C. — Authors' abstract

Storzer, D. *See* Reimer, G. M. 06824

Strange, J. N. *See* Whalin, R. W. 06723

Streatfield, David. *See* Twiss, Robert. 06920

06655 **Street, R. L.; Chan, R. K. C.; Fromm, J. E.** The numerical simulation of long water waves — Progress on two fronts, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 453-473, illus., 1970.

Two numerical, finite-difference models have been developed and programmed for the study of long water waves, with particular application to aspects of tsunami propagation. The study has been confined to plane flows and the numerical results have been verified by comparison with experiments. Specific objectives of the work were the exact simulation of finite-amplitude waves near the shore and simulation, based on approximate equations, of long waves in moderately shallow water, e.g., on the continental slope and shelf. In the latter simulation, the effect of the bottom hydrography on waves is of prime interest. In the exact simulation, the results include the details of the wave motions such as breaking inception, pressure distributions,

and water particle motions. The results presented illustrate the agreement between experiments and simulations, as well as potential application of the simulation methods. — Authors' abstract

07111 **Streib, Donald L.** Tectonic analysis of the area of Wheeling, West Virginia: West Virginia Acad. Sci. Proc. 1969, v. 41 (West Virginia Univ. Bull., ser. 70, no. 11-3), p. 189-193, illus., 1970.

Two major vertical joint systems, created in the Wheeling area during folding, result from horizontal compressive stress. The more prominent of the two has sets oriented at N. 75° W., N. 55° W., and N. 35° W.; the first and last form a set of conjugate shears, and are bisected by the set at N. 55° W., which parallels the maximum compressive stress. The second, less fully formed system, has sets oriented at N. 30° E., N. 45° E., and N. 55° E.; the first and last form conjugate shears, and the set at N. 45° E. the tension fracture. The second system formed with tension fracture parallel to regional structure. A series of shear fractures in the Pittsburgh coal, occupied by clay dikes, arranged in an en echelon pattern, and oriented at N. 12° W., were probably formed by vertical compressive stress created by uplift during folding. Block settlement observed along both sides of the Ohio River, was probably caused by erosional release joints. — *from* Author's abstract

Strimple, H. L. *See* Furnish, W. M. 00173

06857 **Strom, Robert G.; Fielder, Gilbert.** Multiphase eruptions associated with the lunar craters Tycho and Aristarchus: Arizona Univ. Lunar and Planetary Lab. Commun., v. 8, pt. 4, no. 150, p. 235-288, illus., 1970.

Numerous volcanic features occur within and in the vicinity of both Tycho and Aristarchus. The floors probably consist of lava; widespread deposits surrounding the craters probably resulted from base surges. Volcanism may have been triggered by large impacts which tapped a subsurface source of magma. Limited volcanism may be present now. Aristarchus is probably 1.6 times older than Tycho. — JHF

06611 **Strong, Ceylon Perseus, Jr.** Physical and biostratigraphic relations of the Colorado Group in west-central Montana [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 765B, 1970.

00179 **Strude, Gerald R.** Paleobathymetry aids exploration: World Oil, v. 172, no. 2, p. 47-48, illus., 1971.

Ecological studies of living Foraminifera provide an accurate framework for paleobathymetric interpretations. Details show how exploration for hydrocarbons improves when these interpretations are used with standard structural and stratigraphic methods. — Author's abstract

06504 **Stumpfl, E. F.** New electron probe and optical data on gold tellurides: Am. Mineralogist, v. 55, nos. 5-6, p. 808-814, illus., tables, 1970.

Electron probe analysis of sylvanites reveals considerable compositional variations in specimens from different deposits. Gold contents are frequently higher than suggested by the formula $AuAgTe_4$. Spectral reflectivity values increase with increasing gold content. In spite of deviations from stoichiometry, the compositional field of sylvanite is clearly separated from those of krennerite and of calaverite. Nagyagite corresponds to the composition $Pb_{5.09}Au_{0.77}Sb_{1.10}(Te_{2.02}S_{5.43})_{7.45}$ (Cripple Creek) and $Pb_{5.09}Au_{0.89}Sb_{1.06}(Te_{2.23}S_{5.40})_{7.63}$ (Nagyag). — Author's abstract

06768 **Stumpfl, E. F.; Halls, C.** Tektonik und Vererzung im Cobalt-Gebiet, Canada — Einige neue Aspekte (Tectonics and mineralization in the Cobalt area of Canada — Some new aspects (with English abs.)], *in* Experimental and natural rock deformation — Internat. Symposium, Darmstadt, Germany, 1969, Proc. (P. Paulitsch, editor): Berlin and Heidelberg, Germany, Springer-Verlag, p. 517-525, illus., 1970.

Structural investigation of silver deposits in the Cobalt district, Ontario, reveals the significance of primary fracture patterns in the Keewatin basement for the development of silver-bearing lodes in the Huronian. The Penokean (1200 m.y.) and the Grenville orogeny (880 m.y.) resulted in post-platform tectonic activation of the Cobalt block, generating fault systems which acted as channelways for mineralizing solutions. Co-Ni-Ag-mineralization is polyascendent; there are four structurally and mineralogically defined types of ore veins. — Authors' English abstract

Stumpfl, E. F. *See* Gibb, F. G. F. 06855

00190 **Subbotin, S. I.** Additional stresses and phase transformations in the Earth's upper mantle: Jour. Geophys. Research, v. 76, no. 5, p. 1447-1449, illus., 1971.

It is inferred that the Earth has been inhomogeneous throughout its history. These inhomogeneities are the starting point of the Earth's tectonic history. The inhomogeneities produce stress concentrations that, through high values of thermodynamic variables, lead to volume changes in regions of the Earth's geosphere. Variations in certain volumes of the upper mantle material are immediately responsible for movements in the overlying mantle and crust of the Earth. These deformations are chiefly vertical. It is essential that a thorough understanding be gained about the processes of the crust and especially about the processes within the Earth's mantle, which is the source of crustal material and energy for crustal movements. — Author's abstract

Suddueth, J. E. *See* Nargolwalla, S. S. 06553

Sullivan, L. B. *See* Brede, E. C. 06737

06696 **Swanson, Roger W.** Geologic map of the Melber quadrangle, Graves and McCracken Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-860, scale 1:24,000, section, text, 1970.

Principal resources of the Melber quadrangle are: clay of ceramic quality from the Wilcox and Claiborne Formations; gravel from continental deposits and alluvium for road material; sand from Eocene strata for road fill and building-site preparation; and ground water mainly from the Wilcox and Claiborne Formations. — MCM

06591 **Swanson, Stephen Robert.** Development of constitutive equations for rocks [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 711B, 1970.

07075 **Tailleur, I. L.; Brosgé, W. P.** Tectonic history of northern Alaska, *in* Geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970, Proc.: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., p. E1-E20, illus., discussion, 1970.

A geanticlinal fold belt or orogen forms the Brooks Range and bordering foothills, and a deformed successor basin adjoins on the north and underlies the remainder of the slope. The north edge of the orogen incorporates less competent Paleozoic and Mesozoic rocks and northward migrating hingelines into a Disturbed Belt of intricate structure along the western and central mountain fronts. Folded, faulted strata that filled the successor basin now underlie the northern foothills. The basement under the foothills rises northward onto the north flank of the successor basin. Each end of the Brooks Range is strongly deflected in trend and the crust of Arctic Alaska appears to have been foreshortened. Evidence for the southeastward drift of the Siberian-Chukchi shelf and that northern Alaska and the Arctic Archipelago were joined during much of their history is reviewed. — VSN

Tailleur, I. L. *See* Brosge, W. P. 07104

06784 **Takagi, Shunsuke.** Comparison of plane strain and triaxial tests on sand — Discussion [of paper 7276 by Kenneth L. Lee, 1970]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 6, p. 2163-2167, illus., 1970.

Paper 7276 was published ibid., v. 96, no. SM 2, p. 901-923, 1970; *see* Abs. North American Geology, February 1971.

06703 **Talwani, Manik.** A system for the reduction, display, and storage of marine geophysical data, *in* Marine geodesy, a practical view — Symposium on Marine Geodesy, 2d, 1969: Washington, D. C., Marine Technology Soc., p. 169-187, illus., table, 1970.

A system of reduction, display, and storage of marine geophysical data is described which allows storage of large quantities of digitized raw topographic, magnetic, or gravity data acquired underway, as a time series. Also stores are 'navigation points' which describe ships' tracks in digital format. A 'navigation point' is defined as a point where a ship altered speed and/or course. These storage files can then be employed in a large number of programs which reduce the data and display it in graphic form or as annotation on charts. The system allows rapid acquisition, reduction, and display of data with large economy in storage and with no appreciable sacrifice in computing speed. The computer used is the IBM 1130 with interchangeable magnetic disk cartridges and a Calcomp plotter; the system can be modified for use with other computers. — *from* Author's abstract

Tappan, Helen. *See* Loeblich, Alfred R., Jr. 07045

06903 **Tarkoy, Peter J.** Upper Cambrian Maynardville Formation within the Clinchport fault belt of East Tennessee: Illinois Acad. Sci. Trans., v. 63, no. 3, p. 305-318, illus., 1970.

First defined by Oder (1934), the relationships of this formation have been the subject of controversy, due to its transitional nature. Although there is a definite change of lithology from the Nolichucky Shale, the basal Maynardville boundary is gradational. The upper boundary is even less well-defined, being determined by the relative abundance of lithologic criteria. From study of 16 measured sections along a 70-mile segment of the Clinchport fault belt, the Maynardville can be divided into four persistent parastratigraphic units, having conclusive evidence of supratidal to intratidal origin of dolomite and limestone, respectively. The Maynardville Formation is a mappable unit even though transitional. — *from* Author's abstract

Tarr, A. C. *See* Engdahl, E. R. 06970

06851 **Tatsumoto, Mitsunobu.** U-Th-Pb age of Apollo 12 rock 12013: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 193-200, illus., tables, 1970.

A U-Th-Pb isotopic study of three chips from lunar rock 12013 indicates that the prenatal material of the intrusion breccia formed quite early in the Moon's history, possibly 3.9 to 4.3 b.y. ago. The U-Th-Pb characteristics of the rock are distinctly different from those of other Apollo 12 igneous rocks and suggest a different origin. — Author's abstract

06853 **Taylor, Hugh P., Jr.; Epstein, Samuel.** Oxygen and silicon isotope ratios of lunar rock 12013: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 208-210, illus., table, 1970.

The δO-18 and δSi-30 values of six whole-rock samples from the high-SiO_2 lunar rock 12013,10 are very uniform at + 5.95 to + 6.34 and -0.49 to -0.07, respectively. These data are very similar to those obtained on terrestrial basalts and gabbros, the previously analyzed Apollo 11 lunar rocks, and terrestrial rhyolite obsidians from oceanic areas. Rock 12013 is, however, distinctly lower in O-18 than tektites and terrestrial plutonic granitic rocks, strongly suggesting that tektites do not come from the Moon. — Authors' abstract

Taylor, Lawrence A. *See* Finger, Larry W. 06976

06502 **Tettenhorst, Rodney; McGuire, Robert C.** Implications of hydroxyl-oxygen juxtaposition in layer silicates: Am. Mineralogist, v. 55, nos. 5-6, p. 735-741, illus., tables, 1970.

Observed (OH)-O directions in dickite and chlorite are used to formulate models for the orientation of monohydric alcohol molecules on montmorillonite surfaces. The T-O-T angle in layer silicates is related to the surface oxygen configuration and may be an important structural parameter. The free swelling of montmorillonites in water and the orientation of the hydroxyl group in muscovite are related to the clay organic complexes. — Author's abstract

Textoris, D. A. *See* Dennison, J. M. 06791

06932 **Thakur, T. R.; Scheidegger, A. E.** Chain model of river meanders: Jour. Hydrology, v. 12, no. 1, p. 25-47, illus., 1970.

For a sound theoretical basis for statistical analysis of river meanders, it is necessary to calculate expectation values of certain observables (such as the meander spectrum) over a well-defined ensemble. Attempts to set up such ensenbles numerically have not been successful because of the difficulty of random-generating meander patterns for given boundary conditions. Thus, an empirical approach has been used. In the present study a necklace chain of a given length L was used to generate theoretical meanders. Keeping both ends of the chain fixed and M units apart, an ensemble of random profiles of a given sinuosity can be generated. Different ensembles can be generated by varying the distance M and keeping the length of the chain constant. Expected values of statistical relations are found from the ensembles in order to make a comparison with the data obtained from actual rivers. — *from* Authors' abstract

Thomas, R. L. *See* Cronan, D. S. 06941

07038 **Thompson, A. E.; Stokes, W. L.** Stratigraphy of the San Rafael Group, southwest and south central Utah: Utah Geol. and Mineralog. Survey Bull. 87, 50 p., illus., 1970.

Outcrops of the San Rafael Group and the Morrison Formation along the southern margins of the Markagunt and Paunsaugunt plateaus and the western, southern, and eastern Kaiparowits Plateau have been mapped and correlated with type sections of San Rafael Swell and Black Mesa Basin. The formations are predominantly sandy, fossils are rare except in limy portions of the Carmel, and facies changes are rapid in all units. A key to distribution patterns and causes of many previous miscorrelations is the influence of a regional northeast-dipping sub-Cretaceous unconformity cutting through all the members of the Entrada between Escalante and Sevier fault, and through the upper Carmel before Hurricane Cliffs. — *from* Authors' abstract

06906 **Thompson, Esther H.** Morphology and taxonomy of *Cyclonema* Hall (Gastropoda), Upper Ordovician, Cincinnatian province: Bulls. Am. Paleontology, v. 58, no. 261, p. 219-284, illus., 1970.

Mature whorls of this gastropod appear to consist of three layers of original calcite. The genus is an early member of the Platyceratidae which were coprophagous on crinoids and cystoids. Most species were probably detrital feeders and ill-adapted to a sedentary mode of life. *Cyclonema* inhabited normal marine waters with a firm substrate, free of mud. Species are differentiated on shell shape, aperture shape, and ornament. *Cyclonema* seems to have been derived from *Holopea*, a high-spired form with a smooth, polished surface with only collabral lirae, and was probably the ancestor of typical, uncoiled, sedentary platyceratids. Many *Cyclonema*-like forms of Ordovician to Devonian age should be referred to other genera. Those species from the Upper Ordovician of the Cincinnati region are described and illustrated. — *from* Author's abstract

Thompson, James B., Jr. *See* Hovis, Guy L. 07029

00130 **Thomsen, Leon.** Elastic shear moduli and crystal stability at high P and T: Jour. Geophys. Research, v. 76, no. 5, p. 1342-1348, illus., tables, 1971.

This paper presents new theoretical expressions for the elastic velocities (of a cubic or isotropic homogeneous solid) as functions of density and temperature. These

equations have been derived within the fourth-order anharmonic theory, i.e., the extension of the theory of lattice dynamics into the regime of finite strain, and they include implicitly the effects of noncentral forces, distant-neighbor interaction, and thermal vibration. Application of the equations to garnet, spinel, and olivine (considered as Voigt-Reuss-Hill isotropic bodies) confirms and lends rigor to the present consensus on the elasticity of the mantle. The equations indicate further that the observed instabilities of these materials under upper mantle conditions are not directly related to vanishing of an elastic modulus. — Author's abstract

06915 **Tien, Pei-lin; Bauleke, Maynard P.** A method for preparing pelleted clay samples of semi-micro quantity for differential thermal analysis [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 18, no. 3, p. 179-181, illus., 1970.

A semi-micro quantity (10-15 mg) sample of clay is pressed into a 3 mm diameter pellet for differential thermal analysis (DTA) in a STONE-TRACOR ring microsample holder. The pellet is transferred to the sample holder dish with a vacuum tweezers. Platinum sample dishes are also handled by vacuum tweezers to avoid denting the dishes or damaging the thermocouple wires. The DTA curves obtained by the pellet method are highly reproducible. The resolution and sensitivity of reaction peaks are equivalent to or better than those produced by a large sample (200 mg) packed into a nickel block holder. — Authors' abstract

Titulaer, C. *See* Fryer, R. 06842

00117 **Toksöz, M. Nafi; Minear, John W.; Julian, Bruce R.** Temperature field and geophysical effects of a downgoing slab: Jour. Geophys. Research, v. 76, no. 5, p. 1113-1138, illus., tables, 1971.

Finite-difference calculations of the temperature field of a downgoing lithosphere slab are carried out and the relative effects of different parameters are investigated. Errors in the method are shown to be small and reducible to any level by varying the grid size and time steps. For crustal spreading of 8 cm per yr, with all heat sources, the slab reaches thermal equilibrium with the surrounding mantle at about 650 km depth. Seismic traveltimes and amplitudes provide most information about the slab; surface heat flow is sensitive to relatively shallow subsurface conditions, and gravity anomalies are broad and masked by crustal effects. Three-dimensional calculations predict strong bending of seismic rays near slabs, causing strong focusing and producing shadow zones. Traveltimes for the Tonga-Fiji region indicate that waves propagating down the slab from shallow events are advanced by about 4 sec. — DBV

Toksoz, M. Nafi. *See* Minear, John W. 00145

Toksoz, M. Nafi. *See* Minear, John W. 00193

00118 **Torrance, K. E.; Turcotte, D. L.** Structure of convection cells in the mantle: Jour. Geophys. Research, v. 76, no. 5, p. 1154-1161, illus., table, 1971.

This paper demonstrates the feasibility of using numerical calculations to determine the structure of convection cells within the mantle. A temperature and depth-dependent viscosity appropriate for diffusion creep is employed. The upper boundary is a rigid surface moving at constant speed; this boundary condition is compatible with plate tectonics. It is found that large flow velocities and small temperature differences are associated with ascending convection, and significant flows extend to a depth of 300 km. The surface heat flow and topography are determined and are in reasonable agreement with observations. — Authors' abstract

07041 **Touchet, B. A.; Daniels, R. B.** A post-Montgomery pre-Prairie age loess near Ville Platte, Louisiana: Southeastern Geology, v. 12, no. 2, p. 83-93, illus., tables, 1970.

An area of post-Montgomery loess 14 × 18 miles overlies the Montgomery terrace north of Ville Platte, Louisiana. The loess overlies a paleosol at the top of the Montgomery Formation so it postdates the Montgomery, but it predates the erosion preceding deposition of the Prairie Formation because it is truncated by the Prairie-

Montgomery escarpment. The present work modifies the work of Daniels and Young (1968) by shifting the west border of the post-Prairie loess to the east near Ville Platte and essentially eliminating the post-Prairie loess from the Montgomery terrace. — Authors' abstract

06746 **Tozer, D. C.** Factors determining the temperature evolution of thermally convecting earth models, *in* Geophysical studies on the evolution of the Earth's deep interior — A symposium, Madrid, 1969, Proc.: Physics Earth and Planetary Interiors, v. 2, no. 5 (spec. issue), p. 393-398, illus., 1970.

The thermal history of the Earth is posed as a problem in convection theory. The concept of stabilization temperature is introduced and its significance for the cooling process is assessed. The rapidity of heat transport at higher temperatures combined with the fact that stabilization temperatures are only half the melting temperature, cf. the classicial literature of cooling from a 'hot origin,' makes present temperatures relatively insensitive to initial conditions. — Author's abstract

Trescott, Peter C. *See* Wanless, H. R. 06708

07064 **Trimble, Stanley W.** The Alcovy River swamps — The result of culturally accelerated sedimentation: Georgia Acad. Sci. Bull., v. 28, no. 4, p. 131-141, illus., 1970.

Historical evidence is drawn upon to show that the Alcovy River swamps, in the Piedmont of Georgia, were almost nonexistant before modern farming practices developed. Before 1814, early accounts do not mention swamps, and historical accounts after that indicate conditions other than those which now exist. — HRC

Troup, Arthur G. *See* Harriss, Robert C. 06564

Tsang, Tung. *See* Ghose, Subrata. 00195

Turcotte, D. L. *See* Torrance, K. E. 00118

Turcotte, D. L. *See* Oxburgh, E. R. 00128

Turcotte, D. L. *See* Schubert, Gerald. 00137

00192 **Turekian, Karl K.; Bertine, Kathe K.** Deposition of molybdenum and uranium along the major ocean ridge systems: Nature, v. 229, no. 5282, p. 250-251, illus., 1971.

Anomalously high concentrations of U and Mo found in surface sediments of oceanic rises have been attributed to volcanic activity. It is proposed here that most of the sediments with high U and Mo concentrations found on seismically active and in relatively inactive rises reflect the formation of anaerobic sediments, in part the result of formation of ephemeral basins along the ridges and in part the result of the high rate of supply of organic material to the relatively shallow ocean bottoms along the ridge area. — DBV

07068 **Turner, Grenville.** Ar-40:Ar-39 age determination of lunar rock 12013: Earth and Planetary Sci. Letters v. 9, no. 2, p. 177-180, tables, 1970.

Two samples of lunar rock 12013 (12013, 10-26 white fragment with high K and 12013, 10-43, dark inclusion with low K) have been analyzed by the Ar-40:Ar-39 technique. Ar-40:Ar-39 ratios measured in a stepwise heating experiment on both samples was essentially constant and equal throughout, indicating a uniform Ar-40:K ratio in both samples. There is no evidence of any appreciable amount of Ar-40 loss, neither is there any evidence of excess argon in the two small samples analyzed. The Ar-40:Ar-39 ratio in both samples, when compared with that in a terrestrial monitor irradiated alongside, corresponds to a K-Ar age of $3.87 \pm 0.07 \times 10^9$ yr. — Author's abstract

06726 **Turnock, A. C.** A pyroxene solvus section: Canadian Mineralogist, v. 10, pt. 4, p. 744-747, illus., 1970.

An experimental determination of a solvus on the join $Mg_{0.2}Fe_{0.3}Ca_{0.5}SiO_3$-$Mg_{0.4}Fe_{0.6}SiO_3$ for total pressure of 20 Kb, shows a two-phase region of augite ± orthopyroxene. The maximum calcium content of the orthopyroxene on the solvus is 7 ± 5 percent Wo ($CaSiO_3$), and shows no change with increasing temperature in the range 800 to 950°C. The minimum calcium content of augite is 25 ± 5 percent Wo at 800°C, 15 ± 5 percent at 950°C, so that with increasing temperature the stability field of augite is extended to a low $CaSiO_3$ content. — Author's abstract

06920 **Twiss, Robert; Streatfield, David; Kojan, Eugene; Magill, Arthur W.** Nicasio — Hidden valley in transition: San Rafael, Calif., Marin County Plan. Dept., 50 p., illus., tables, geol. map [1970,].

This report consists of an analysis of environmental and natural and historical bases of landscape quality of the Nicasio Valley, a compact oval-shaped watershed of about 36 sq mi underlain by the Cretaceous Franciscan Formation. Major units are graywacke, metamorphic rocks, spillite, quartzite, chert, serpentine, and alluvium. Recent natural and artificial changes have contributed to increased erosion of slopes. The town of Nicasio is five miles east of the San Andreas fault, so in the event of a major earthquake in the region, it can be expected that many existing landslides will be reactivated and enlarged. Ground water is found mainly in alluvium over the Franciscan and is available in varying, but small quantities. Effects of the reservoir built in 1961 on ground-water table and sedimentation rates are not yet known. Goals for design of the environment are summarized. — MCM

Tynan, Edmund C. *See* Vaughan, George B. 06799

06921 **U.S. Bureau of Reclamation.** Senator Wash Dam, Dikes, and Pumping-Generating Plant — Technical record of design and construction: Denver, Colo., U.S. Bur. Reclamation, 198 p., illus., tables, geol. maps, 1970.

This technical record of design and construction of the Senator Wash Dam, Dikes and Pumping-Generating Plant in southeastern California contains a chapter, in Part I — Introduction, on the geology of the area and maps of the regional geology and geology of the reservoir vicinity. The geologic history is given, and the stratigraphic sequence and engineering properties of foundation materials are included in tables. Reservoir hydrogeology, including ground-water movement and seepage, is briefly covered. Requirements and local availability of construction materials are given in Part II — Design. — EH

00140 **U.S. Geological Survey.** Aeromagnetic map of the Mount Grace quadrangle and part of the Northfield quadrangle, Franklin and Worcester Counties, Massachusetts, and Cheshire County, New Hampshire: U.S. Geol. Survey Geophys. Inv. Map GP-726, scale 1:24,000, 1971.

00141 **U.S. Geological Survey.** Aeromagnetic map of the Royalston quadrangle, Worcester and Franklin Counties, Massachusetts, and Cheshire County, New Hampshire: U.S. Geol. Survey Geophys. Inv. Map GP-727, scale 1:24,000, 1971.

00142 **U.S. Geological Survey.** Aeromagnetic map of the Winchendon quadrangle, Worcester County, Massachusetts, and Cheshire County, New Hampshire: U.S. Geol. Survey Geophys. Inv. Map GP-728, scale 1:24,000, 1971.

00143 **U.S. Geological Survey.** Aeromagnetic map of parts of the Goldfield, Mariposa, and Death Valley 1° by 2° quadrangles, Nevada-California: U.S. Geol. Survey Geophys. Inv. Map GP-753, scale 1:250,000, 1971.

00174 **U.S. Geological Survey.** Aeromagnetic map of the Ashby quadrangle, Middlesex and Worcester Counties, Massachusetts, and Hillsborough County, New Hampshire: U.S. Geol. Survey Geophys. Inv. Map GP-730, scale 1:24,000, 1971.

00175 **U.S. Geological Survey.** Aeromagnetic map of the Townsend quadrangle, Middlesex and Worcester Counties, Massachusetts, and Hillsborough County, New Hampshire: U.S. Geol. Survey Geophys. Inv. Map GP-731, scale 1:24,000, 1971.

00176 **U.S. Geological Survey.** Aeromagnetic map of the Pepperell quadrangle, Middlesex County, Massachusetts, and Hillsborough County, New Hampshire: U.S. Geol. Survey Geophys. Inv. Map GP-732, scale 1:24,000, 1971.

00177 **U.S. Geological Survey.** Aeromagnetic map of the Nashua South quadrangle, Middlesex County, Massachusetts, and Hillsborough County, New Hampshire: U.S. Geol. Survey Geophys. Inv. Map GP-733, scale 1:24,000, 1971.

00178 **U.S. Geological Survey.** Aeromagnetic map of the Lowell quadrangle, Middlesex and Essex Counties, Massachusetts, and Hillsborough County, New Hampshire: U.S. Geol. Survey Geophys. Inv. Map GP-734, scale 1:24,000, 1971.

00194 **U.S. Geological Survey.** Aeromagnetic map of the Ashburnham quadrangle, Worcester and Middlesex Counties, Massachusetts, and Cheshire and Hillsborough Counties, New Hampshire: U.S. Geol. Survey Geophys. Inv. Map GP-729, scale 1:24,000, 1971.

06562 **U.S. Geological Survey.** Geological Survey research 1970, Chap. A: U.S. Geol. Survey Prof. Paper 700-A, p. A1-A425, illus., 1970.

This summary of U.S. Geological Survey research includes a review of economic and scientific work on: resources investigations; geologic and hydrologic principles, processes and techniques; geology and hydrology applied to engineering and the public welfare; astrogeology; remote sensing and advanced techniques; geologic and hydrologic investigations in other countries; topographic surveys and mapping; and computer technology. The following information is included also: publications program of the Survey; cooperators and other financial contributors during fiscal year 1970; U.S. Geological Survey offices; investigations in progress in the Conservation, Geologic, and Water Resources Divisions; contents of Geological Survey research 1970, Chapters B, C, and D (U.S. Geol. Survey Prof. Papers 700-B, 700-C, 700-D, 1970), a bibliography and index of publications by Survey authors in fiscal year 1970; and subject and investigator indexes. — MCM

06699 **U.S. Geological Survey.** The national atlas of the United States of America: Washington, D. C., U.S. Geol. Survey, 417 p., illus., 1970.

In addition to general reference maps, the atlas contains special subject maps: (1) physical — landforms, geophysical forces (gravity, earthquakes, magnetism), geology, marine features, soils, climate, water; (2) history; (3) economic; (4) socio-cultural; (5) administrative; (6) mapping and charting; and (7) world. Map subjects are indexed, explanatory texts accompany many maps, pertinent data are tabulated, and a gazetteer index is included. — MCM

07074 **U.S. Geological Survey; Am. Association of Petroleum Geologists; Northern California Geological Society; Adkison, W. L.; Brosge, Mary M.** (editors). Proceedings of the geological seminar on the North Slope of Alaska, Palo Alto, Calif., 1970: Los Angeles, Calif., Am. Assoc. Petroleum Geologists Pacific Sec., papers paged separately, illus., table, 1970.

Following three introductory papers, this proceedings volume contains 16 papers, all of which are cited separately. The last three papers (by the Alaska Geological Society, Rudolph W. Kopf, and Donald J. Orth, respectively) were not presented at the seminar. — VSN

Vail, Ruth S. *See* Wanless, H. R. 06708

Vail, V. *See* Slade, D. V. 06624

06675 **Vali, V.** Earth strain measurements with a one kilometer laser interferometer, *in* Laser applications in the geosciences (J. Gauger and F. F. Hall, Jr., editors) — Symposium, Huntington Beach, Calif., 1969, Proc.: North Hollywood, Calif., Western Periodicals Co., p. 153-162, illus., 1970.

The study of earth strains over a relatively large sample of the surface has become possible with development of the laser as a source of coherent light. For unambiguous results a modified Fabry-Perot or an unequal arm Michelson interferometer must be used, and the coherence length of the light beam must exceed twice the arm length of the interferometer. The instrument described and illustrated here is a modified Fabry-Perot type that is located in a tunnel of 4 km length at Stevens Pass, Washington. Details of installation are given. Records obtained from observations in May and June of 1968 are illustrated. One of the deficiencies of the system has been the uncertainty of stability of laser wavelength; a stabilizer system consisting of a one-meter-long fuzed quartz cylinder is being constructed. — VSN

VanAndel, S. I. *See* Hospers, J. 06686

Vandenberg, A. *See* Lennox, D. H. 06931

06585 **Vandergraaf, Tjalle Thys.** Some aspects of neutron activation analysis of silicate rocks [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 557B-558B, 1970.

06642 **VanDorn, William G.** A model experiment on the generation of the tsunami of March 28, 1964 in Alaska, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 33-45, illus., table, 1970.

Analysis of the wave record for this tsunami, obtained from a special tsunami recording station at Wake Island, suggests that the tsunami originated from a line source in the form of a monopolar uplift of half-breadth about 20-30 km. Dispersive waves superimposed on the broad uplift are predicted by theory for such an uplift. A laboratory experiment is described showing that the essential features of such a source can be represented by a one-dimensional model. — Author's abstract

00167 **VanValen, Leigh.** The history and stability of atmospheric oxygen: Science, v. 171, no. 3970, p. 439-443, 1971.

Berkner and Marshall's (1964) theory of the evolution of the Earth's atmosphere attributes the gradual rise and rapid fluctuations in the oxygen concentration in the atmosphere to changes in the rate of photosynthesis. It is argued here that the conclusions and the argument leading to them must be modified. There are three weakly concentration-dependent processes that keep changes in atmospheric pressure from being a random walk — inhibition of net photosynthesis by oxygen, passage of hydrogen through the oxidizing part of the atmosphere before it escapes the Earth, and burial of reduced carbon in anaerobic water. A strong regulator seems desirable but remains to be found. The cause of the initial rise in oxygen concentration presents a serious and unresolved quantitative problem. — DBV

06799 **Vaughan, George B.; Tynan, Edmund C.; Yen, Teh Fu.** Vanadium complexes and porphyrins in asphaltene — [Pt.] 2, The nature of highly aromatic substituted porphyrins and their vanadyl chelates: Chem. Geology, v. 6, no. 3, p. 203-219, illus., tables, 1970.

Previous work has pointed out the existence of porphyrins of higher aromaticity in petroleum asphaltenes. This investigation is to further explore this finding and especially to examine some model porphyrins with highly aromatic substituents and their metallo chelates. Ten meso-tetraaryl-porphyrins and their vanadyl chelates were synthesized and their properties were studied by a number of spectral methods such as U.V.-visible, infrared, N.M.R., mass and E.S.R. Their characterizations are reported here for the first time. — Authors' abstract

06681 **Vaz, Jesus Eduardo.** Thermoluminescence-metamictization relations in zircon [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 765B, 1970.

06550 **Verhoogen, John.** Paleoheat flow, Chap. 38 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 359-363, illus., 1970.

This review of paleoheat flow and techniques of measuring it is based primarily on the work of F. J. Turner (1968, 1960) on assemblages of mineral phases in metamorphic rocks. — VSN

Vierbuchen, Richard C. *See* Doehring, Donald O. 06956

Viger, H. L. *See* Brede, E. C. 06737

Vilcsek, E. *See* Begemann, F. 06821

06793 **Viramonte, J. G.; DiScala, L.** Summary of the 1968 eruption of Cerro Negro, Nicaragua: Bull. Volcanol., v. 34, no. 1, p. 347-351, illus., table, 1970.

The 1968 eruption of Cerro Negro began during the night of October 23, preceded by small tremors. Lava reached the surface through several cracks near the volcano foot, and almost concurrently two small vents about 10 m apart began to emit incandescent spatter, building an adventive cone feeding in an aa lava flow. Explosive activity of the principal cone began the next day. Ash rained on an area of about 3,000 sq km. Eventually the flow reached a maximum length of about 1,700 m and width of 700 m. Most of the ejecta from the principal crater (maximum 40 cm diameter) fell on the volcano slopes, but small impact craters were found about 250 m downwind. An interesting phenomenon was simultaneous eruption of basaltic and siliceous pyroclastics from the principal crater, the latter in very small volume; there were also some siliceous inclusions in the scoria formed by the adventive cone. Activity of the adventive cone ceased on December 6; a few days later the principal crater subsided to a fumarolic state which continues. — DBV

06493 **Viswanathan, S.** A classification of granitic rocks with reference to Giants Range batholith, northern Minnesota [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 40-43, illus., 1970.

06752 **Vitousek, Martin; Miller, Gaylord.** An instrumentation system for measuring tsunamis in the deep ocean, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 239-252, illus., 1970.

An instrumentation system has been developed which is capable of measuring tsunamis in the open ocean in depths to about 6 km. Six have been built and tested, five being used in a recent experiment in the Aleutians. The recording systems have been designed to operate over long periods of time, to record open-ocean tides. The instrumentation is described. The Amchitka experiment did not provide an opportunity to measure tsunamis in the open ocean, but it did provide an excellent test of the instrumentation system. A new series of measurements in the North Pacific is planned. — DBV

Volz, Gary. *See* Mooney, Harold M. 06582

Voytko, George A. *See* Orchard, R. J. 06782

Wager, L. R. *See* Kempe, D. R. C. 07059

06807 **Wagner, Donald E.** Nuclear yields from Rayleigh waves: Earthquake Notes, v. 41, no. 3, p. 9-20, illus., tables, 1970.

Maximum A/T ratios of Rayleigh waves are measured at continental WWSSN stations to predict nuclear yields of eleven events at the Nevada Test Site. A revision of

Richter's surface wave magnitude to $M_s^1 = 2.4 + \log (A/T_{+12}) + 1.6 \log (\Delta)$ is verified. R Author's abstract

Wagner, G. A. *See* Reimer, G. M. 06824

Wagner, Walter R. *See* Kelley, Dana R. 06534

Wainerdi, R. E. *See* Kuykendall, W. E., Jr. 06664

06569 **Wakeley, John R.** The unique beach sand at Rodeo Cove: California Div. Mines and Geology Mineral Inf. Service, v. 23, no. 12, p. 238-241, illus., 1970.

Beach sand at Rodeo Cove, Calif., is very different in both grain size and composition from that in all beaches north and south of Tennessee Cove. The northern half is a barrier bar, and the southern, a narrow strip of sand at the base of low cliffs. The entire watershed feeding the beach at Rodeo Cove is underlain by the Jurassic-Cretaceous Franciscan Formation, composed mostly of chert and arkosic graywacke cut by milky quartz veinlets. Hills overlooking the southern half are capped by an eolian sand of Sierran origin, whose red-brown color contrasts with the white sand beaches common along this coast. Average diameter of the beach material is 0.97 mm; chert, averaging 3.20 mm comprises 55 percent of the sand at Rodeo Cove, occuring only in the coarser portion. Carnelians occur as amygdules and weather out of volcanic rocks. Size relationships are controlled by particle composition, abrasion, and primary grain size. — ESL

06848 **Wakita, H.; Schmitt, R. A.** Elemental abundances in seven fragments from lunar rock 12013: Earth and Planetary Sci. Letters, v. 9, no. 2, p. 169-176, illus., tables, 1970.

Abundances of major (Ti, Al, Fe, Ca, Na, and K), minor (Cr, Mn, and Ba), and trace (Sc, V, Co, Hf, La, Sm, Eu, Yb, Lu, Th, and U) elements were determined by INAA. With few exceptions, average abundances agree with those obtained by LSPET. K and Ba vary linearly over a six-fold K and threefold Ba in abundance pattern; Th, U, K, and Ba vary sympathetically with Si. Rare earths are similar in five and different in two fragments. Eu, relative to chondrites, is severely and variably depleted in all fragments. Average REE abundances and Sm:Eu ratio in 12013 suggest this rock is more closely related to Apollo 12 soil than Apollo 12 rocks. Interelement correlations suggest 12013 is composed of two principal fractions: an alkali-barium feldspar and a fraction consisting of minerals that are related to the composition of Apollo 12 soil. — *from* Authors' abstract

06838 **Wakita, Hiroshi; Schmitt, Roman A.** Lunar anorthosites — Rare-earth and other elemental abundances: Science, v. 170, no. 3961, p. 969-974, illus., tables, 1970.

Elemental abundances of major, minor, and trace elements in lunar anorthosites separated from Apollo 11 sample 10085 coarse fines have been determined by instrumental and radiochemical neutron activation analysis. The REE distribution pattern of lunar anorthosites, relative to ordinary chondrites, has a positive Eu anomaly. On the assumption that (1) the lunar composition is similar to that of ordinary chondritic meteorites low in total Fe (about 13 percent); (2) lunar anorthosites are derived from highland cratering events and are representative of the highlands; and (3) the Moon differentiated into olivine, hypersthene, and basaltic and anorthositic phases, and plagioclase crystallization began after about 93 percent solidification, then mass balance calculations yield about 30-km and about 10-km thicknesses for the lunar highlands for the melting and chemical differentiation of the entire Moon and of the upper 200 km, respectively. Corresponding thicknesses of the basaltic basement rocks were about 5 km and about 2 km, respectively. —*from* Author's abstract

Waldbaum, David R. *See* Hovis, Guy L. 07029

Walker, R. *See* Burnett, D. S. 06846

06523 **Walker, Robert F.; Motts, Ward S.** Reconnaissance geology of Big Smoky Playa, Nevada, Chap. 4 *in* Geology and hydrology of selected playas in western United States (Ward S. Motts, editor) — Univ. Massachusetts, Geology Dept., Contract AF19(628)-2486, Final Sci. Rept., Pt. 2: Bedford, Mass., U.S. Air Force Office Aerospace Research, p. 137-165, illus., tables, 1970.

Big Smoky Playa is encircled by well developed shoreline features which suggest that the location of Pleistocene Lake Tonopah influenced its size and shape. In 1965 its surface types ranged from a hard smooth surface (23 percent) underlain by relatively dry sediments to depths of 5-15 feet; a salt-encrusted soft puffy surface (30 percent) underlain by a shallow water table at 3-5 feet, and a transition surface having some characteristics of each (47 percent), with a dry crust underlain by moister and darker sediments. No water-bearing zone was found beneath the transition surface in augur holes up to 20 feet deep. Ground-water discharge from a shallow aquifer apparently controls the formation of soft puffy ground. Giant dessication polygons, about 50 yards on a side, are present in two areas totaling about 350 acres. The location of high phreatophyte mounds near the playa margin is controlled in part by artesian conditions in shallow aquifers. — DBV

Wallace, D. E. *See* Spangler, D. P. 06731

06722 **Walling, James M.; Freeman, Dale; Adams, William M.** Initiating an IBM System/360 Document Processing System for tsunami research using an existing KWIC index data base, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 477-484, 1970.

In 1967 a Keyword-in-Context (KWIC) index of tsunami literature was compiled, and abstracts were since added to the bibliographic data, punched into IBM cards to serve as input for the KWIC index. In 1969 this data base was selected as the first input for a System/360 Document Processing System. This is a set of programs which convert machine-readable document data into searchable data sets, search these sets, and produce various bibliographies and index listings. Information is stored in context and retrieved by context-oriented search questions. Keywords and bibliographic data are extracted directly from incoming document records. Input records will include abstracts but may include full text also, if desired. Output will consist of document numbers, bibliographies and optionally, a full-text printout. When available the original documents are stored in microfiche form, in a reader with 5-sec access time. — DBV

07100 **Walper, Jack L.** Wrench faulting in the mid-continent: Shale Shaker, v. 21, no. 2, p. 32-40, illus., 1970.

Clockwise rotation of the North American block results in regional shear couples with left-lateral movement. The late Paleozoic and early Mesozoic in the mid-continent were dominated by three major lineaments, referred to as megashears. The Wichita megashear comprises the major faults of southern Oklahoma. Walper agrees with Moody (1962) on the east-west orientation of compressional stresses and the left-lateral direction of shear. These major zones deep within the crust produce drag folding in overlying strata. In contrast to Moody's interpretation, the Balcones fault zone is considered to be a tensional feature and not continuous with the Ouachita Mts. With the Wichita and Texas megashears moving in a left-lateral direction, a zone of tension forms between them, explaining formation of the Gulf of Mexico and all other tensional features. Another continental megashear in Mexico is suggested. — ESL

00181 **Walton, William R.** New geological concepts will help find more oil: World Oil, v. 172, no. 3, p. 95-99, 1971.

Recent advances in the fields of geology and geochemistry have vastly expanded knowledge of rock and fluid properties. Use of newly developed scientific techniques in prospective unexplored areas — and in established producing trends — will be of significant help in finding critically needed reserves. — Author's abstract

06708 **Wanless, H. R.; Baroffio, James R.; Gamble, James C.; Horne, John C.; Orlopp, Donald R.; Rocha-Campos, Antonio; Souter, J. Edwin; Trescott, Peter C.; Vail, Ruth S.; Wright, Cynthia R.** Late Paleozoic deltas in the central and eastern United States, *in* Deltaic sedimentation, modern and ancient: Soc. Econ. Paleontologists and Mineralogists Spec. Pub. 15, p. 215-245, illus., tables, 1970.

Environmental mapping of Pennsylvanian and Mississippian rocks from Oklahoma to Pennsylvania has shown that many masses of sandstone and shale are parts of deltaic complexes. Accumulation of clastic wedges of shale and sandstone followed brief marine transgressions. Widespread marine limestones may terminate against shale wedges interpreted as delta-front deposits grading up into more sandy shales and succeeded by conformable sheet sands or lenticular sandstones. Source areas for sands of the Appalachian Basin lie to the north, east, and southeast; for Illinois basin and northern Midcontinent, northeast and north; for Oklahoma, south, southeast, and southwest. Sediment sources were the Canadian Shield, Appalachian Highlands, and Ouachita Mts. and Arbuckle Mts. uplifts. Delta surface configuration was an important determinant of distribution and thickness of Pennsylvanian coals. Examples of deltas are illustrated. — *from* Authors' abstract

Ward, J. *See* Boyne, H. S. 06627

Ware, N. G. *See* Essene, Eric. 06971

07097 **Washburn, A. L.** An approach to a genetic classification of patterned ground, *in* Problemy Czwartorzędu: Acta Geog. Lodziensia 24, p. 437-446, table, 1970.

The proposed classification is based on five premises: polygenetic origin of patterned ground; similar forms due to different genetic processes; some genetic processes producing different-appearing forms; more of these processes than recognized terms for associated forms; and desirability of simple and self-evident terminology. Table 1, in matrix form, combines accepted terms for geometric pattern, nonsorted and sorted, with those for genetic processes initial with respect to origin of basic pattern — circles, nets, polygons, steps, or stripes. Sorting processes are not included unless they also act as an initial patterning process. In Class I genetic processes, cracking is the essential and immediate cause of the patterned-ground forms; in Class II processes cracking is nonessential. Involutions and solifluction, associated with many kinds of patterned ground, are omitted. — GDC

06494 **Watkinson, David H.** Geology of the alkalic rock-carbonatite complex at Prairie Lake, Ontario [abs.], *in* ; Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 44, 1970.

Watson, G. H. *See* Macpherson, J. G. 06747

Watterson, J. *See* Escher, A. 06763

Wayman, M. L. *See* Evans, M. E. 06822

00186 **Weertman, J.** Theory of water-filled crevasses in glaciers applied to vertical magma transport beneath oceanic ridges: Jour. Geophys. Research, v. 76, no. 5, p. 1171-1183, illus., 1971.

The theory describing the behavior of glacier crevasses partially filled with water is developed further, and applied to the problem of vertical magma transport beneath oceanic ridges. It is assumed that lava collects beneath the center of a ridge. If a tensile stress acts across a ridge cold enough to behave as an elastic plate, a crack filled with liquid rock will nucleate at the bottom surface of the plate. This crack will increase in length and volume, pinch its lower end shut, and finally rise toward the top surface. Eventually the crack will stop, and the lava in it will freeze and cause the oceanic ridge to spread somewhat. Lava will spill out onto the top surface only if an oversize crack reaches the upper surface. A crack that has been preceded by other cracks on its upward journey will be trapped in the interior of the plate, and its lava will freeze in place. — *from* Author's abstract

Weidner, Jerry R. *See* Ghose, Subrata. 06988

Weill, D. F. *See* Drake, M. J. 06844

06711 **Weimer, Robert J.** Rates of deltaic sedimentation and intrabasin deformation, Upper Cretaceous of Rocky Mountain region, *in* Deltaic sedimentation, modern and ancient: Soc. Econ. Paleontologists and Mineralogists Spec. Pub. 15, p. 270-292, illus., table, 1970.

Late Cretaceous sedimentation rates inferred in the Rocky Mountains and Great Plains regions are about 1 inch/1000 yr near the geographic center of the basin where mostly biogenetic materials were deposited (Niobrara Formation) and 20 to 40 times greater in equivalent shoreline zones. These rates agree with modern estimates for Quaternary deep water and shoreline zones of the Atlantic. The Holocene of the Gulf and Atlantic coasts and the Cretaceous of the Western Interior both demonstrate that maximum sedimentation is in the shoreline zone with highest rates in deltaic centers. Within the Cretaceous basin, differential rates of sedimentation influenced rates of subsidence; downwarping was accentuated in some areas by sediment loading in the shoreline zone. Interdelta structural highs, developed between rapidly subsiding delta areas, controlled early migration of petroleum. Wamsutter and Douglas-Moxa arches developed in Late Cretaceous in this manner. — VSN

Weiss, Clair W. *See* Heald, Emerson F. 07015

00191 **Welch, Stewart W.** Awakening the Black Warrior basin: Oil and Gas Jour., v. 69, no. 4, p. 155, 158, 163, illus., 1971.

A brief discussion is given of the petroleum exploration history, geologic structure, source beds, and potential source beds of the Black Warrior basin, Alabama and Mississippi. The depositional and structural history of favorable drilling objectives, ranging in age from Cambro-Ordovician to Pennsylvanian, are summarized. — WBC

06685 **Wells, John W.** Problems of annual and daily growth-rings in corals, Chap. 1 *in* Palaeogeophysics (S. K. Runcorn, editor): London and New York, Academic Press, p. 3-9, illus., 1970.

The small annulations or rings which characterize the epithecax of rugose corals, especially in the Paleozoic, evidently reflect a rhythmic fluctuation in thickness or rate of secretion of the epitheca, analogous in form, but not necessarily in origin to those induced by seasonal temperature variations and on a much smaller scale: annual bands span 6 to 20 or more mm, while fine growth lines range from 12 to 60 per mm. Some of the possible mechanism leading to this structure are: daily fluctuations in nutrient supply, tidal flux, and temperature variations; diurnal variations in terrestrial magnetism; and biologic clock control. Some results obtained on Paleozoic corals as to the number of days in a year strongly indicate that the number of days per year has decreased. A change from 412 days in Upper Ordovician to 371 days in Cretaceous time is shown. — VSN

06710 **Wermund, E. G.; Jenkins, W. A., Jr.** Recognition of deltas by fitting trend surfaces to upper Pennsylvanian sandstones in north-central Texas, *in* Deltaic sedimentation, modern and ancient: Soc. Econ. Paleontologists and Mineralogists Spec. Pub. 15, p. 256-269, illus., 1970.

Upper Pennsylvanian strata, correlated in 2500 wells in 28,000 sq mi of north-central Texas, are representative of the late Paleozoic Eastern Shelf of the Midland basin. Strata are subdivided into 22 nearly isochronous stratal intervals. Results of trend-surface maps of sandstone facies are presented here. Fitting trend surfaces to sandstone percentage allows interpretation of depositional environment and provenance. Patterns of positive residuals in 4th order polynomial trend-surface maps of sandstone percentage permit recognition of deltas and bars. Examples of deltaic advance and retreat, and of reworking of older deltaic deposits into bar deposits, are apparent. Interpretation of positive residuals and trend-surfaces supports provenance migration during Pennsylvanian deposition. — *from* Authors' abstract

06612 **West, Ronald Robert.** Marine communities of a portion of the Wewoka Formation (Pennsylvanian) in Hughes County, Oklahoma [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 2, p. 766B, 1970.

06723 **Whalin, R. W.; Bucci, D. R.; Strange, J. N.** A model study of wave run-up at San Diego, California, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 427-451, illus., tables, 1970.

Wave intrusion into San Diego, Calif., harbor was investigated for prototype wave periods of 40 to 186 sec and deep-water wave heights of 12 to 45 feet; such waves lie between wind-wave and tsunami-wave spectrums. The Silver Strand, the city of Coronado, and portions of North Island were completely inundated for most conditions tested, and wave heights in the restricted harbor entrance approached 26 feet. An extreme circulation pattern resulted from the large volume of water crossing the Silver Strand into the inner harbor; return flow through the navigation channel measured as high as 10 fps. Oscillations, reflections, rip currents, and bores were observed in the smaller partially enclosed basins, bays, and creeks surrounding the harbor. — DBV

07052 **Whisonant, Robert C.** Paleoecology and depositional environments of the Parkwood Formation, Central Alabama: Southeastern Geology, v. 12, no. 2, p. 135-149, illus., tables, 1970.

This formation is a clastic unit of Carboniferous age comprising gray, thin-bedded, medium- to fine grained, poorly sorted sandstones and gray to black siltstones and shales. Paleoecological analysis of fossils collected at six localities indicates deposition in low-energy, shallow, nearshore marine and transitional enviroments, dominated toward the end by tidal flats, salt, brackish and fresh-water marshes, and possibly lagoons. Sedimentary features such as soft-pebble conglomerates, intraformational conglomerates and coals further substantiate the postulated environments. The formation is part of a late Paleozoic regressive sequence that prograded westward across the area. During late Parkwood time, frequent shoreline shifts resulted in intertonguing of continental coal beds with marginal marine strata. — *from* Author's abstract

Whitcomb, James H. *See* Hanks, Thomas C. 00146

00182 **Whitnack, G. C.; Martens, H. H.** Arsenic in potable desert groundwater — An analysis problem: Science, v. 171, no. 3969, p. 383-385, illus., tables, 1971.

An accuracy investigation, initiated because of conflicting analytical data on the arsenic content for some 24 drinking water locations in the Mojave Desert, revealed that interference with the evolution of arsine in the American Public Health Association silver diethyldithiocarbamate method caused either color enhancement or arsine suppression. For certain types of natural waters this method is unreliable. — Authors' abstract

06581 **Whittaker, E. J. W.; Wicks, F. J.** Chemical differences among the serpentine "-polymorphs", a discussion [of paper by N. J. Page, 1968]: Am. Mineralogist, v. 55, nos. 5-6, p. 1025-1047, illus., tables, 1970.

After elimination of unsatisfactory analyses from those treated statistically by Page (ibid., v. 53, p. 201-215, 1968; *see* Abs. North American Geology, December 1968), the remainder are inconsistent with the conclusion that lizardite has relatively high SiO_2 and low Al_2O_3 and that antigorite has relatively large numbers of trivalent tetrahedral ions. Other systematic variations in the composition of the serpentine minerals become apparent, however. — *from* Authors' abstract

Wicks, F. J. *See* Whittaker, E. J. W. 06581

Wiesmann, Henry. *See* Hubbard, Norman J. 06849

06652 **Williams, John A.; Jordaan, Jan M., Jr.** A laboratory model of a double-humped wave impingent on a plane, sloping beach, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 367-376, illus., 1970.

The results of preliminary experiments on the generation of double-humped waves on a plane, sloping beach are presented. The experimental equipment and procedures are discussed. The generated wave form and the ensuing run-up are compared with the numerical results of J. P. Butler, which are based on the theoretical work of G. F. Carrier and H. P. Greenspan. — Authors' abstract

06884 **Williams, Karl Wendel.** Principles of cementation, environmental framework and diagenesis of the Grayburg and Queen Formations, New Mexico and Texas [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 257B-258B, 1970.

Williams, R. S., Jr. *See* Cronin, J. F. 06942

06575 **Williams, Sidney A.; McLean, W. John; Anthony, John W.** A study of phoenicochroite, its structure and properties: Am. Mineralogist, v. 55, nos. 5-6, p. 784-792, illus., tables, 1970.

The poorly described species phoenicochroite occurs at several localities in Arizona. Material from the Potter-Cramer mine provides new information. Phoenicochroite is associated with crocoite, cerussite, mimetite, and vauquelinite in the oxidized zone of galena veins. Analyses give a composition corresponding to $Pb_2O(CrO_4)$. The mineral is dark, cochineal red, and has a yellowish orange streak. Hardness is 2.5, and specific gravity is 7.01. It occurs as anhedral cleavable translucent masses. Crystallographic and optical data are given. — JWC

Williamson, Douglas B. *See* Duncan, William M. 07090

06806 **Willis, David E.; Wilson, James T.** A note on the Anna, Ohio earthquake of July 26, 1968: Earthquake Notes, v. 41, no. 3, p. 21-25, illus., 1970.

A small earthquake located near Anna, Ohio was recorded on the University of Michigan's special well system on July 26, 1968. The body wave magnitude was determined to be 3.0 with a Modified Mercalli intensity of at least III. Spectral analyses showed that most of the seismic energy was contained in a band from 3 to 10 Hz. — Authors' abstract

Willman, H. B. *See* Frye, John C. 06985

07085 **Wilmoth, Benton M.** Environmental geologic hazards of West Virginia: West Virginia Acad. Sci. Proc. 1969, v. 41 (West Virginia Univ. Bull., ser. 70, no. 11-3), p. 174-183, illus., 1970.

Geologic conditions that result in damage to life or property may be either natural or man-made. Natural features that present the most problems in West Virginia are landslides in areas where thick beds of soft shale form most of the land surface, karst topography consisting of extensive solution voids and hard carbonate rock pinnacles, areas of poor natural drainage, and small covered natural faults. Moreover, man's activities can accelerate the potential threat of any of these features. Specific man-made hazards as a result of industrial alterations of the geologic environment are land subsidence from mining, coal bed fires, mine-water flooding, mine refuse areas, subsurface disposal of wastes, and contamination of fresh ground water aquifers. — Author's abstract

Wilson, Charles W., Jr. *See* Barnes, Robert H. 07099

Wilson, James T. *See* Willis, David E. 06806

00154 **Wimbush, Mark; Sclater, John G.** Geothermal heat flux evaluated from turbulent fluctuations above the sea floor: Jour. Geophys. Research, v. 76, no. 2, p. 529-536, illus., tables, 1971.

Heat flux values measured in the sediment with a 2.5-meter Bullard probe agreed with the values determined from spectrums of temperature and current measured in the water within a meter of the ocean bottom. This agreement, together with the absence of significant long-term temperature fluctuations in the abyssal water, suggests that above-bottom heat flux measurements may be practical. — Authors' abstract

06720 **Winkler, E. M.** The importance of air pollution in the corrosion of stone and metals: Eng. Geology, v. 4, no. 4, p. 327-334, illus., 1970.

Sulfates and CO_3 are strongest corrodents of stone; CO and organic irritants are only minor. Raindrop absorption of CO_2 when cold nearly doubles; especially strong is attack on carbonate rocks, and surface reduction in cities is expected to be double that of rural counterparts. Urban weathering of igneous rocks cannot yet be predicted. Calcite in windblown dust readily reacts with acids in rainwater to convert the sulfate ion to gypsum; reaction of silicate volcanic dust is negligible. Cosmic dust has an estimated fallout of 30 tons per yr, cf. 30 million tons for all natural dust combined. Rapid increase of CO_2 by complete combustion can lead to warming of Earth's surface and faster corrosion. Without a switch to new power sources, conservation efforts may cut down on the neutralizing dust, and more acid rainwater seepage will harden ground water. — GDC

Winter, T. C. *See* Bidwell, L. E. 07049

07109 **Wintz, William A., Jr.; Kazmann, Raphael G.; Smith, Charles G., Jr.** Subsidence and ground-water offtake in the Baton Rouge area: Louisiana Water Resources Research Inst. Bull. 6, [90] p., illus., tables, 1970.

Precise leveling in the Baton Rouge area in the summer of 1969 showed land subsiding at a variable rate because of ground-water offtake; from 1964-69 the surface in the industrial area center had sunk 0.3 feet. A map with contour lines of subsidence and maps of ground-water elevations in principal aquifers show a cause-effect relation; in each of two instances, an isolated area of subsidence outside the principal center of pumping coincides with location of an individual well field. Additional subsidence of at least 0.4 feet will occur by 1974. If net offtake from deep aquifers is not reduced at once, total maximum subsidence in the industrial area center could reach 5 feet or more by 1990. The Baton Rouge fault is active with the downthrown side dropping at a maximum rate of about 0.02 feet per year. An appendix contains descriptions of the 116 benchmarks used in the leveling survey. — *from* Authors' abstract

06800 **Wolf, Karl H.** A collection of scientific sayings and quotations [Pt.] 2: Earth-Sci. Rev., v. 6, no. 5, p. 353-368, 1970.

The following is a contination of the series of sayings and quotations, publication of which began in Earth-Science Reviews 6(4), p. 289-296 [Abs. North American Geology, May 1971], and which will be completed in the next issue 6(6). An introductory text explaining the background to and the objectives of this collection of quotations is to be found on p. 289-291 of the preceding issue. — Author's abstract

Wolf, S. C. *See* Grantz, Arthur. 07076

07092 **Wollin, Jay C.** Dig that coral — Rockhounding in Florida: Gems and Minerals, no. 399, p. 24-26, 42-45, illus., 1970.

Recently, in the Ballast Point area of Hillsborough Bay near Tampa, more chalcedonized coral pieces have been collected yearly than during the entire last century; they may be dug from bay-bottom clay below weathering limestone chunks of the Tampa Formation. There are *fingers*, or branched forms, and *heads*, the brain coral, unattached to any base, and most showing signs of abrasion from rolling around; the original reef has not been found. Opened, they are geodes lined with agate and chalcedony, some preserving corallite structure; the rarest have centers of small quartz crystals. Externally gritty, the coral and associated small shells apparently started to weather before silicification, which may be very recent. Coral from the bay bottom is

almost every color but red; that from dry land almost always some shade of red, oxidized iron. — GDC

06538 **Wolman, M. Gordon; Leopold, Luna B.** Flood plains, [Chap.] 6 *in* Rivers and river terraces (G. H. Dury, editor): London, Macmillan and Co. Ltd., p. 166-196, illus., tables, condensed 1970; originally published 1957.

This paper is concerned with the process, a combination of deposition on the inside of river curves and deposition from overbank flows, that is responsible for most flood plains on great rivers. In most of the 39 rivers listed, the annual flood attains or exceeds the level of the flood-plain surface every year or every other year. Two types of deposits make up a flood plain: the point bar, and the overbank deposits; the proportion of the latter is small. The flood plain can only be transformed into a terrace by some tectonic, climatic, or man-induced change which alters the regime of a river. This paper was originally published as U.S. Geol. Survey Prof. Paper 282-C. — ESL

Wolman, M. Gordon *See* Leopold, Luna B. 06539

Wones, David R. *See* Czamanske, Gerald K. 06945

Woo, C. C. *See* Duke, M. B. 06963

06662 **Wood, G. V.** Sediment thin section data, Chap. 14 *in* Initial reports of the Deep Sea Drilling Project — V. 4, Leg 4 of cruises of *Glomar Challenger*, Rio de Janeiro, Brazil, to San Cristobal, Panama, Feb.-Mar. 1969 (R. G. Bader, and others): Washington, D. C., U.S. Govt. Printing Office, p. 315-323, table, 1970.

The report consists of tables showing observable porosity, particle size, packing, particulate components (carbonate and noncarbonate, skeletal and nonskeletal), matrix or cement, and structures and textures, for offshore Brazil and the Caribbean Sea cores. — ESL

06495 **Wood, John.** Evidence for a tropical climate and oxygenic atmosphere in upper Huronian rocks of the Rawhide Lake-Flack Lake area, Ontario [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 45-46, 1970.

06501 **Wood, Michael M.** The crystal structure of ransomite: Am. Mineralogist, v. 55, nos. 5-6, p. 729-734, illus., tables, 1970.

In ransomite, a hydrous copper-iron sulfate, the iron coordination octahedra are concentrated in bands one octahedron wide and two deep, which extend in the *a* axial direction. Individual iron octahedra of the bands are linked by sulfate tetrahedra, and translational equivalent bonds are connected through these tetrahedra by distorted copper coordination octahedra to form sheets parallel to (010). The sheets are joined by hydrogen to account for the perfect (010) cleavage. The complexity of metal sulfate hydrate structures is suggested to be a function of the percentage of oxygen atoms of the sulfate tetrahedra that are involved in coordination of the metal cations. — *from* Author's abstract

Woodrow, Donald L. *See* Fletcher, Frank W. 06680

Woods, Michael J. *See* Brookins, Douglas G. 06555

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Wright, Cynthia R. *See* Wanless, H. R. 06708

00185 **Wyllie, Peter J.** Role of water in magma generation and initiation of diapiric uprise in the mantle: Jour. Geophys. Research, v. 76, no. 5, p. 1328-1338, illus., 1971.

The best explanation for the low-velocity zone involves incipient melting due to traces of water. Water rising from the deep mantle in preferred zones augments the interstitial silicate magma at the base of the low-velocity zone, initiating diapiric uprise necessary for basaltic magma generation. A lens of gabbro-rich material in the suboceanic mantle may account for the gravity anomaly and seismic refraction results at mid-ocean ridges. The low-velocity zone should not be continuous beneath island arcs. Magma may be generated beneath island arcs by partial melting of downgoing oceanic crust by frictional heat, migration of water from lithosphere into overlying mantle, or diapiric uprise of material from downgoing lithosphere. The composition of the liquid generated depends on many variables including water content and stability of hydrous minerals. Magma generation may depend on the regime of water rising from the deep mantle in preferred zones and carried down with the lithosphere in Benioff zones. — DBV

Yen, Teh Fu. *See* Vaughan, George B. 06799

07072 **Young, Davis Alan.** Petrology and structure of the west-central New Jersey highlands [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 1, p. 258B, 1970.

06496 **Young, Grant M.** Widespread occurrence of aluminous minerals in Aphebian quartzites [abs.], *in* Inst. Lake Superior Geology, 16th Ann., Thunder Bay, Ontario, 1970, Tech. Sess. Abs. and Field Guides: Thunder Bay, Ontario, Lakehead Univ., p. 47-48, 1970.

Yuhas, D. *See* Burnett, D. S. 06846

06656 **Zetler, B. D.** Report of the International Union of Geodesy and Geophysics Tsunami Committee, *in* Tsunamis in the Pacific Ocean — Internat. Symposium on Tsunamis and Tsunami Research, Honolulu, Hawaii, 1969, Proc.: Honolulu, Hawaii, East-West Center Press, p. 485-487, 1970.

This is a report on the meeting of the Tsunami Committee of the IUGG, on October 10, 1969, following the Tsunami Symposium in Honolulu, Hawaii. — DBV

06833 **Zimmerman, J. H.** Plant ecology of the Baraboo hills [summ.], *in* Geology of the Baraboo district, Wisconsin: Wisconsin Univ. Geol. and Nat. History Survey Inf. Circ. 14, 78-81, 1970.

Among influences on the present biota in the Baraboo region are the very diverse soils, reflecting the variety of parent materials such as glacial till, lake deposits, eolian sand, dolomite, sandstone, quartzite, and talus, and the topography, including large valleys with talus slopes, narrow shaded gorges and smaller glens, and broad valleys with bouldery swamp basins. The Driftless area, of which the western half of the Baraboo district is a part, provided a refugium at least during the last (wisconsinan) glacial stage, for an especially rich collection of relic plant communities. Above the gorges and on tops of bluffs and their south-facing slopes, are many postglacial invaders from the south. Man's agricultural and industrial activities have altered the local ecology markedly, though less than might be expected. — GDC

Zortea, Michel. *See* Peyches, Ivan. 00136

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